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FOREIGN MILITARY REVIEW

No 9, September 1989

Organization of Military Scientific Research in the U.S. Defense Department

904Q0003A Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) pp 3-7

[Article by Lt Col S. Yakushev]

[Text] The U.S. leadership views military scientific research as a very important analytical tool used in making decisions on the broadest range of problems of organizational development and employment of the U.S. Armed Forces. Military science in the United States bears a clear-cut class character, reflects the interests of the ruling monopolistic bourgeoisie and military-industrial complex, and substantiates the need for building up the country's military might and preparing its Armed Forces for aggressive operations in any region of the globe.

Pentagon representatives admit that the rapidly changing world military-political situation, the scientific-technical revolution, and the qualitative leap in military affairs elevate military theory's role in the activity of U.S. Armed Forces. Efforts directed toward building up the combat power and combat readiness of the U.S. Army, Air Force and Navy would be substantially weakened without military scientific support. U.S. military specialists emphasize that savings in recent years from redirecting Armed Forces development programs based on recommendations and conclusions contained in research exceeded research expenditures by several times.

Requirements for substantiating scientific recommendations increase, the subject matter of military theoretical development widens, and the forms and methods of research activity are perfected as the role of military scientific research grows. American specialists believe that the effectiveness of scientific work depends considerably on the quality of its organization. Planning and financing research in the military-theoretical sphere as well as monitoring progress of the research process are important aspects of U.S. Defense Department activity in this regard.

Military scientific activity in the United States is organized under a five-year plan for Armed Forces development which includes a program for their organizational development called "Research, Development, Test and Evaluation [RDT&E]." It is broken down into parts or categories. One part, designated "Direction and Support," plans research on the basis of specific program items which contain directions of research activity to implement the five-year plan. Each item has an alphanumeric code. For example, military-theoretical support of JCS scientific activity is carried out within the scope of item 65104D. In particular, such research as a "general war model," "model of nuclear conflict in a theater of war, from limited to general," "repelling an attack by nuclear missile and air forces of the Warsaw Pact in the Central European Theater of Operations," "NATO nuclear weapons in a theater of war," "capabilities of chemical weapons," "methodology of a comparative assessment of the sides' armed forces in a theater of war" and so on has been performed in recent years.

The analytical study coordinator plays the chief role in the process of organizing scientific work in the Defense Department. He is appointed from among heads of the staff of the under secretary of defense for acquisition. His duties include the following:

—Provide overall direction of research performed in Defense Department interests;

—Coordinate Defense Department military-theoretical activity with studies being done by branches of the U.S. Armed Forces as well as with certain government agencies;

—Monitor research records in Defense Department organizations and the exchange of information among them;

—Prepare an annual consolidated account with an assessment of Defense Department scientific activity.

In addition, each directing entity of the Defense Department has its own analytical study coordinator (subordinate to the head of that entity or to a specially designated person). He must perform the following basic duties: coordinate questions of organization of his department's research with the U.S. Defense Department coordinator; monitor the organization of development of general directions of scientific work in accordance with Secretary of Defense directives; coordinate the planning, financing and monitoring of research within the scope of his own organization; monitor timely presentation of complete information on research being done by his organization to the U.S. Defense Technical Information Center.

Military scientific activity in the United States is organized on the basis of general principles of military planning and provides for each organization's preparation of an annual "Initial Plan of Priority Requirements." This document includes the most important directions of research, in the opinion of the interested agency's leadership, in accordance with that entity's requirements and resources. Initial plans are submitted to the U.S. Defense Department analytical study coordinator, who generalizes them and sends them out for familiarization and evaluation (in the form of working documents) to staffs of the armed services' secretaries as well as to other central military departments. This permits identification of research directions which duplicate each other. The data obtained are used for preparing

the Defense Department scientific research plan for the following fiscal year, which is approved by the Secretary of Defense.

The Defense Department leadership believes that consideration of the initial scientific research plans by interested departments facilitates an improvement in the quality of their planning and economy of resources allocated for this activity. Following the annual examination of the plan up to 25 percent of the requests, which duplicate work already done or being done or which are of no value for the Defense Department, may be eliminated from it.

Specialists in organizing military-theoretical activity believe that joint analysis of initial plans additionally permits identifying research directions which reflect common interests of different organizations. In this case the interested parties plan the financing and conduct of RDT&E under a unified program. For example, research which includes a comparative analysis of rates of modernization of the U.S. and USSR armed forces was organized jointly by the under secretary of defense for acquisition, the director of program analysis and evaluation, and the director of the Office of Net Assessment of the Defense Department. Military scientific research projects are elaborated and implemented not only through joint efforts of U.S. departments, but also with the inclusion of establishments subordinate to NATO's Supreme Allied Commander Europe.

Official Pentagon documents point out that this organization of the planning process permits involving all interested military departments in it, encourages them to allocate larger amounts for joint research, increases the effectiveness of coordination among them, and enables eliminating aimless research projects and timely amendments and supplements to plans for theoretical work. At the same time the Defense Department leadership allows a partial overlap of research subjects in the course of planning based on the fact that one and the same problem may be solved using different analytical methods.

The bulk of research in the sphere of military theory is done under contracts or corresponding agreements (guarantees, orders, contract letters and so on). Military scientific work performed by the faculty and students of higher military educational institutions according to thematic lists which are sent out by interested organizations make up only an insignificant part of the overall volume of RDT&E.

Immediate organization of the work process is implemented on the basis of U.S. Secretary of Defense Directive No 4205.2 "Defense Department Consultative Services Under Contract," published in January 1986 and valid for the staffs of the secretary of defense and offices of the Defense Department, secretaries of the armed services, the JCS, and unified and specified commands. It takes in all theoretical activity conducted in the interests of the Armed Forces regardless of the financing source, the contractual form, and the executing organization.

The process of organizing research presumes the involvement of three parties: the client, i.e., the department interested in conduct of military scientific work, which monitors the research process and uses its results; the executing body—a scientific research organization fulfilling the order and responsible for its quality; and an official person who monitors compliance with rules for formalizing and fulfilling the contract. The functions of the person responsible for the contract can be performed by the client by mutual consent of the parties. In those cases where research requires an expansion in the scope of work or assumes an especially important nature, consultative entities of the Defense Department or individual consultants (specialists on the corresponding subject matter and on the Armed Forces) may take part in its organization in addition to the official parties. In individual instances, if the client does not have sufficient capabilities to direct the research or monitor its conduct he may turn for help to private firms specializing in providing services for organizing the research process, or directly to the executing body.

A significant number of U.S. scientific research centers have their own facility for organizing and conducting RDT&E. In addition, many of them lately have been establishing special entities which advise the client and give him recommendations on concluding a contract with a given research organization, and if necessary they can assume the functions of the party monitoring compliance with the contractual agreement. Such major scientific research centers as the Rand Corporation and the Defense Research Institute, which have powerful administrative staffs, often draw up a plan in advance for conducting profitable research (for which they propose to obtain an order) with the objective of increasing the client's interest in efficient management of the research process.

Those who perform research for the U.S. Defense Department are divided into internal and external performers. Scientific research organizations which are part of the table of organizational structure of the Armed Forces as well as individual researchers (both military and civilian) serving in military establishments are considered to be internal performers. External performers include private and public scientific research organizations, university research centers, as well as independent analysts. A special category of scientific research organizations exists in the United States: centers financed by the Defense Department which do not belong to the Armed Forces and so are considered external performers, but they essentially act as internal performers by virtue of their total dependence on the Pentagon.

Agencies interested in solving a particular problem of a military-theoretical nature require less time and funds for organizing the performance of any kind of research done by an internal performer than by those of an

external performer. As a rule, the performer has close administrative or historical ties with the client, and so contact with him presumes a minimum of formality. Sometimes a talk between representatives of the client and internal performer is sufficient to reach a general understanding, which is a guarantee of further joint activity. This also forces external performers to make client activities as easy as possible by assuming not only executive, but also organizational functions. By admission of U.S. specialists, U.S. military scientific research centers do not have such capabilities.

An internal performer is determined using appropriate documents drawn up for clients and containing lists of scientific research centers which indicate their functional missions and primary directions of activity, as well as those spheres of military-theoretical knowledge where a particular center has proven itself to be most competent. Another method of seeking a performer within the Defense Department framework is a query to the Defense Technical Information Center, which has a card file containing information about what has been done for military purposes by whom, when, where, how, on what basis, and with what financial expenditures. A performer thereby is found which has a close relationship with the proposed subject of research, after which the client establishes contact with the organizer or performer of the work to conclude a contract.

A basic agreement and a work request are the equivalents of a contract. The former is developed as a rule as a result of unofficial talks between client and performer. After an agreement is concluded, the planned research is included in the military scientific research establishment's work program and data on it are sent to the Defense Department information system. In case the client should require an upgrading or change in the research project, he sends the performer a written instruction which contains new requirements and amounts of presumed additional expenditures. The work request contains a brief description of requirements for the work and an explanatory note specifying the research task in detail. This is used when it is necessary to assign a task promptly. After the request has been accepted by the performer it acquires the status of an agreement and is financed in the same way as an ordinary contract.

The client monitors performance of research being done by the military scientific research center by telephone or in the course of personal contacts by representatives of both parties. An external performer is obligated to submit monthly written reports containing the following sections: list of basic participants; use of information and technical capabilities of the Defense Department and other government organizations; status of work as of the present moment; research results obtained during the past period; and a financial account.

In addition to performing work on orders, each U.S. Defense Department research center implements its own research program with financing covered by the military RDT&E budget. Under this program Defense Department scientific research establishments organize work on projects being developed independently.

External performers account for the bulk of military-theoretical research under orders. In the assessments of American experts, they perform over two-thirds of the total volume of military RDT&E programs. A significant scientific and analytical potential is concentrated in the private sector, in academic organizations and in scientific research centers financed by the Defense Department. They have a powerful administrative staff. All this makes their services advantageous to the Pentagon. A characteristic feature that plays a substantial role in the wide involvement of external performers is maintenance of close contact between client organizations and their former associates who have shifted to jobs in civilian research centers.

According to a U.S. Secretary of Defense directive on organization and control of military scientific research, work can be assigned to an external performer in the following cases:

—When the client is certain that a positive result can be obtained only when the research is assigned to an external performer;

—When the Defense Department does not have capabilities for effective conduct of necessary research or cannot organize and conduct it in time periods established by the client and in accordance with his requirements;

—When the research envisages use of special areas of knowledge in which the Department has no specialists, and setting up its own facility for performing it is economically unprofitable because of the absence of a constant need for it;

—When the planned work does not fall within the sphere of Department responsibility and its performance does not require use of its own forces;

—When the Department is given the opportunity of taking advantage of the scientific and technical potential of an external scientific research organization which has highly qualified cadres;

—When the research being done by an external organization under an independent program can be used in the Department's interests;

—When the Department must perform research using the personnel of an independent organization to solve a controversial problem which arose as a result of a clash of interests of different military departments.

The heads of Defense Department establishments have the right to suggest and approve requirements placed on the work of external performers.

When research is conducted by external performers the client's primary tasks are as follows: seeking appropriate

research organizations and establishing a basis for holding a competition among them; choosing the most qualified performers; concluding agreements; providing the performer with the information and technical base of the Defense Department and other government organizations; strictly complying with contractual obligations; monitoring the progress of research; and financing the work.

A research contract can be concluded without competition with an organization which is a sole performer and also when the performer comes forth with an initiative proposal for developing a topic of interest to the Defense Department. A significant portion of orders is placed with external performers without a competitive selection. As a rule, contracts without competition are concluded with scientific research centers financed by the Defense Department and having the closest ties with it.

A scientific research organization which has received a military order under contract has the right to pass on all the work or a portion thereof to another organization (a subcontractor), retaining only administrative functions.

In some cases performers are permitted to do work above the amount provided by the contract. Work of this nature is encouraged by the U.S. Defense Department, since it believes that this serves the cause of developing military science. The amount of unplanned work is discussed with the client.

The Defense Technical Information Center provides considerable help in organizing military scientific research. Each Defense Department agency proposing to organize such activity is obligated to query the Defense Technical Information Center to be sure that it does not duplicate work already done or being done. Results of the query are formalized and kept in the client's dossier, which contains the following information: cost and method of concluding the contract (with or without competition); name of the performing organization; substantiation of the need for conducting such research with an indication of the objectives which the client plans to achieve, his requirements and the priority of research tasks facing him; discoveries or conclusions made in the course of research; their realization; measures conducted in accordance with the conclusions and work recommendations; and an assessment of the performer's work. The dossier is kept for five years or for a longer period if necessary.

American specialists believe that in a number of cases the results of military-theoretical research are used immediately and effectively, sometimes the desired effect cannot be achieved at once, and often its realization is postponed for an indefinite time or it is impossible. Research results can be input to a computer or sent to the archives to augment the data bank. Military experts believe that the effectiveness of any research depends on many reasons, and above all on the complexity of the problem being studied, the performer's analytical capabilities, timeliness of presenting work results, and quality of research management. Pentagon documents admit the impossibility of completely using the results of all military scientific research, but they constantly emphasize the need to struggle to improve the efficiency of military scientific work by improving its organization.

South Korean Armed Forces

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[Article by Col A. Pranov, candidate of military sciences, docent]

[Text] The United States views South Korea as a key area for basing the contingent of American forces in the Western Pacific and as a very important military-strategic springboard for organizing aggression against countries of socialism and suppressing the national liberation movement in Asia. The United States has built 40 military bases and facilities on the Korean Peninsula at which it keeps forward-based forces (over 40,000 persons). At the present time munitions, POL, weapons and other supplies are being stockpiled on the country's territory to support combat operations by allied forces, and American military installations are being constructed with partial financing by the South Korean side.

South Korea's industry provides the Armed Forces with modern weapons and military equipment to a considerable extent. It produces rifles; machineguns; 60-mm, 81-mm and 106.7-mm mortars; 40-mm rocket launchers; 90-mm and 106-mm recoilless rifles; 105-mm and 155-mm howitzers, including self-propelled [SP] howitzers; surface-to-surface and air-to-air missiles; 130-mm 36-tube multiple launch rocket systems; 20-mm Vulcan SP air defense guns; tanks; APC's; various military vehicles; F-5E and F-5F[1] aircraft; fire support helicopters[1]; submarines; missile frigates; missile and patrol craft; small ASW and landing ships; auxiliary vessels; radio communications and radar equipment; ammunition for artillery, small arms, missile and aircraft weapons; and military gear. In addition, armored recovery vehicles, TOW ATGM launchers, Stinger portable SAM systems, Improved Hawk SAM's, counterbattery radars, F-16 aircraft and other combat equipment continue to come from the United States.

Expenditures for the Armed Forces reached $7.2 billion in 1988 (over 33 percent of the state budget).

The South Korean Armed Forces (629,000 persons) are the main support of bourgeois and military circles, which are accelerating the country's militarization, aiming at an expansion of U.S. military presence on the Korean Peninsula, and being drawn more and more into the orbit of American policy in the Far East.

Permanent entities have been formed for effective U.S.-South Korean military cooperation. They include the U.S./ROK Consultative Conference on Security, the U.S./ROK Military Committee, the U.S./ROK Combined Force Command (Seoul), and the Combined Field Army Command.

Supreme military command and control entities (Fig. 1). Under the 1987 Constitution the president is the country's supreme commander of the Armed Forces. There is a National Security Council (prime minister, minister of national defense, minister of foreign affairs, minister of home affairs, chief of the Economic Planning Board, and responsible persons appointed by the president) under the president as the supreme consultative body on questions of military policy, Armed Forces organizational development and other matters. The president exercises direction of the Armed Forces through the minister of national defense (a civilian), and the latter does so with the help of the ministry of national defense staff, the Joint Chiefs of Staff, and commanders in chief of branches of the Armed Forces. A Military Council, which is a consultative body, functions under the minister of national defense.

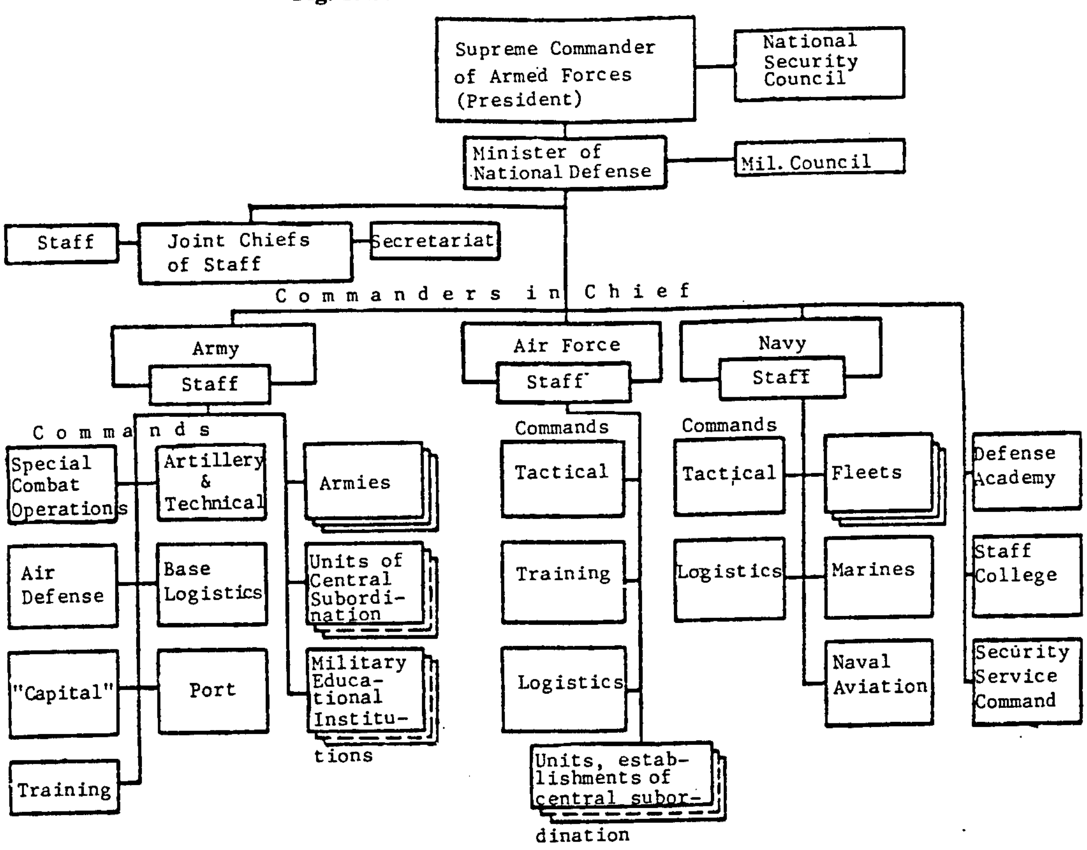
Administrative direction of Army and Navy forces is exercised by commanders in chief of branches of the Armed Forces, whose duties include working out problems of large and small unit organization, manpower acquisition, personnel training, logistic support, and so on.

The **Army** (540,000 persons) is the principal and largest branch of the Armed Forces. According to foreign press data, it is made up of 3 armies (1st, 2d and 3d), 6 army corps, 19 infantry divisions, 2 mechanized divisions, 2 separate Honest John free-flight rocket battalions, 7 separate tank battalions, over 20 separate field artillery battalions, several commands, and other units and subunits. In addition, there are several reduced-strength infantry divisions and 16 separate brigades (2 tank, 2 infantry, 7 special purpose, 2 AAA, 2 SAM and 1 army aviation).

The field army is the main operational formation of the ground forces. It includes up to five army corps (each with 3-4 infantry divisions), one or two separate infantry (or mechanized) divisions, reduced-strength divisions, a signal brigade, field engineer group, army aviation subunit, and other supporting subunits.

The army corps is the highest tactical unit with no permanent composition. In addition to infantry divisions, it includes a tank brigade, artillery brigade and engineer brigade; separate battalions (tank, signal, 1-2 artillery-technical, quartermaster, security, chemical,

Fig. 1. Structure of South Korean Armed Forces



military police, 1-2 motor transport); and support and service units. Other units and subunits can be included in the corps additionally.

The infantry division (15,000-18,000 persons) is the main tactical large unit. It includes a headquarters, three infantry regiments, an artillery regiment (3-4 artillery battalions), four battalions (reconnaissance, tank, combat engineer, and signal), three companies (army aviation, TOW ATGM, and chemical), and support and service subunits.

The mechanized division (15,000 persons) has a headquarters, three brigade headquarters, three mechanized battalions, three motorized infantry battalions, three tank battalions, four artillery battalions, a reconnaissance battalion (on APC's), a combat engineer battalion, signal battalion, army aviation company, and other subunits. Its inventory includes tanks, 12 203.2-mm and 54 105-mm towed howitzers and 155-mm SP howitzers, around 40 106.7-mm mortars, 18 106-mm recoilless rifles and so on.

The separate infantry brigade (3,000-5,000 persons) consists of a headquarters, headquarters company, four infantry battalions, one reconnaissance battalion, and two artillery battalions.

Large and small army units are divided into two categories according to strength level and combat training level: permanent readiness (100 percent strength in personnel, weapons and equipment) and reduced-strength, having 15-20 percent of the personnel and 100 percent of weapons and equipment.

The foreign press reports that the Army inventory includes over 15 operational-tactical and tactical missile launchers, including three Paccom guided missiles and 12 Honest John free-flight rockets; over 1,500 tanks (250 M47 and M48, over 1,140 M48A5K and 60 M60); more than 1,000 APC's (500 M113 and M577, 350 Fiat 6614 and others); over 3,500 field artillery pieces (2,100 M101 105-mm howitzers; 155-mm, 175-mm and 203.2-mm guns and howitzers); more than 5,300 mortars of various calibers; antitank weapons (75-mm and 90-mm SP guns, LAW rocket launchers, 57-mm, 75-mm and 106-mm recoilless rifles, and TOW ATGM's); 600 35-mm and 40-mm antiaircraft guns; Vulcan SP air defense guns; 110 Improved Hawk SAM launchers; 100 Nike-Hercules SAM launchers; 133 Stinger launchers and 600 Stinger missiles; and over 500 army aviation aircraft and helicopters, of which there are 50 fire support helicopters with TOW ATGM's.

Production of Type 88 tanks (Fig. 2 [figure not reproduced]), of which 550 have been ordered, as well as Fiat 6614 APC's has continued since 1987. It is planned to purchase 50 UH-14 Bell and 36 AH-1S Cobra helicopters and the Javelin SAM system.

The **Air Force** (33,000 persons) is intended for conducting combat operations together with U.S. aviation and is called upon to accomplish the following missions: winning air superiority, providing close air support to Army and Navy forces, conducting aerial reconnaissance in the interests of branches of the Armed Forces, screening installations against enemy air attacks, conducting counterinsurgency operations, and supporting the landing and transporting of personnel, equipment and other military cargoes.

The Air Force has tactical, fighter, reconnaissance, transport, special (for counterinsurgency) and auxiliary aviation as well as engineer-technical support and logistic units. Organizationally the Air Force is consolidated in three commands (operational, training and logistics). The first is the main strategic formation of the Air Force. It includes ten air wings (seven fighter, one control and guidance, one training and one transport), an air defense wing and separate squadrons. The training command includes a training wing and the logistic command includes units and establishments of the Air Force rear.

The Air Force's main tactical unit is the air wing, which consists of a headquarters, two or three squadrons, and service subunits. The air squadron is the main air subunit. The South Korean Air Force has over 30 squadrons, including 18 tactical fighter squadrons, 4 air defense fighter squadrons, 5 transport squadrons, 1 reconnaissance squadron and 1 search and rescue squadron.

The Air Force has around 700 aircraft and helicopters, including 473 combat aircraft (F-5A, E & F tactical fighters, F-16 tactical fighters, Fig. 3 [figure not reproduced], F-4D & E air defense fighters, trainers, RF-5 reconnaissance aircraft and others). Transport aviation includes 8 C-130H, 10 C-54, 16 C-123 and 2 HS-748 aircraft, and search and rescue aviation includes 26 UH-1B & H helicopters. There also are up to 40 control and guidance aircraft (O-1E, O-2A and U-17) and around 100 trainers (33 T-33A, 39 T-37C and 20 T-41D). Combat aviation is armed with Sidewinder and Sparrow air-to-air missiles as well as Maverick air-to-surface missiles.

Upgrading and replacement of the inventory is being accomplished with F-4E, F-5E and F-5F aircraft assembled in South Korea. Refitting of two tactical fighter squadrons with F-16 aircraft (Taegu Air Base) purchased in the United States was completed in 1989.

The largest South Korean Air Force bases are Kangnung, Suwon, Kimhae, Taegu, Osan, Kwangju and Chongju.

The **Navy** (54,000 persons) includes three fleets, Marines (25,000), Naval Aviation, and a logistics command. Foreign experts emphasize that they are intended for accomplishing the following primary missions: blockading the Korea Strait together with the U.S. and Japanese navies; giving close support to ground forces operating in coastal sectors; landing tactical assault forces and reconnaissance and raiding parties on the enemy coast; protecting sea lines of communication and maintaining favorable operating conditions in coastal waters.

In peacetime the Navy is used for patrolling territorial waters and the economic zone.

The foreign press notes that the ROK Navy has two main forms of organization—administrative (large and small units based on types of ships, vessels and small combatants in the fleets, and large and small units and subunits in the Marines and Aviation) and operational, introduced in an exercise period, with an aggravation of the situation, and during war.

The fleet includes a squadron of combatant ships consisting of divisions of mixed forces and an off-shore defense squadron as well as individual ships and vessels.

The fleets number 178 combatant ships, auxiliary vessels and small combatants, including 5 submarines, 5 missile destroyers, 6 destroyers, 6 missile frigates, 2 frigates, 12 ASW patrol ships, 9 coastal minesweepers, 8 tank landing ships, 7 landing transports, as well as 105 small combatants (11 missile and 94 patrol).

Naval Aviation includes an air wing, two air groups and ASW squadrons, including helicopter squadrons. There are up to 20 S-2F Tracker combat aircraft, Alouette III helicopters and others in the inventory.

The Marines are headed by a commandant. They include three divisions (one of which is a reserve division), a brigade and separate subunits. There are M48A5 tanks, LVTP-7 amphibious tracked APC's, artillery pieces, mortars, ATGM's, portable SAM systems and other weapons in the inventory.

The main naval bases are Chinhae, Inchon, Pusan, Pohang, Mokpo and Cheju.

According to data published in the foreign press, two "Ulsan"-Class frigates (Fig. 4 [figure not reproduced]), ten HDP-1000 corvettes and three Type 209 submarines (FRG) have been ordered for the Navy and the production of minesweepers is being organized in South Korean yards. The Naval Aviation command ordered ten 500 MD Defender helicopters.

Operational and combat training of ROK Armed Forces personnel is conducted by agreement with the leadership of the U.S. Armed Forces in this country. Great emphasis is placed on joint training of U.S. and South Korean Army and Navy forces, accomplished in the course of day-to-day activities and annual exercises. The largest exercise is the U.S./ROK operational-strategic Exercise Team Spirit, in which war plans are rehearsed on the Korean Peninsula and U.S. capabilities of reinforcing its Army and Navy forces in this region are studied. According to foreign press data, the strength of troops participating in the exercise has remained at a level of 200,000 persons in recent years, of whom over 80,000 are U.S. servicemen. The duration of these exercises has reached 76 days.

Great emphasis is placed on educating personnel in a spirit of anticommunism and antisovietism and developing their necessary moral-political and psychological qualities during combat training.

In the assessment of U.S. JCS specialists, ROK troops are becoming more and more combat-effective, but they still depend on U.S. support of an operational nature.

Manpower acquisition of the ROK Armed Forces is accomplished based on a law on universal military obligation under which all males who have reached their 18th birthday and are fit for service according to their state of health are considered reservists. The period of active duty in the Army and Marines is 2.5 years, and in the Air Force and Navy it is three years.

As the foreign press reports, each year 160,000-200,000 persons are demobilized from the Armed Forces and assigned to the reserve. Overall numerical strength of the Armed Forces reserve exceeded 4.9 million persons, of whom 4.8 million are in the Army, 55,000 in the Air Force and 67,000 in the Navy. The first-order Army reserve numbers 1.4 million persons, and that of the Air Force and Navy includes all personnel of the corresponding reserves. Persons who have served active duty are assigned to it. They are registered with large and small units of regular forces, where they periodically take training courses. On reaching the age of 40 they are transferred to the second-order reserve, to be called up in a period of general mobilization, and at age 50 reservists are removed from military registration.

NCO personnel are made up of soldiers and sailors who have undergone training in training centers and in 16 specialist schools of branches of the Armed Forces, where training is given in 220 specialties.

Officers train in the Defense Academy, in schools and in command and staff colleges of branches of the Armed Forces. The Academy is a higher military educational institution which accepts only general and flag officers and senior-grade officers as well as civilians involved in military problems in their work and having an academic degree of candidate of sciences. The term of training is around a year. Some officers train abroad, primarily in the United States.

Footnotes

1. Assemblies and components delivered from the United States are assembled.

Field Artillery of U.S. "Heavy" Divisions

904Q0003C Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) pp 19-24

[Article by Col I. Aleksandrov]

[Text] The U.S. military leadership links the success of Army combat operations above all with its firepower,

high maneuverability and sufficient striking power. The last Army regulations developed with consideration of chief provisions of the "Air-Land Operation (Battle)" concept note that firepower is the main component of troop combat power and provides an opportunity to engage the enemy by the fire of all weapons at the disposal of the combined-arms commander.

Foreign military periodical publications emphasize that field artillery, which makes the most substantial contribution to the firepower of combined-arms formations (especially when conducting combat operations without the use of nuclear weapons), is the primary means of effective engagement in the ground forces. In the opinion of U.S. military specialists, field artillery, with weapons characterized by high precision of fire as well as simplicity of design and flexibility of fire, can successfully accomplish a wide range of combat missions both in the offensive and on defense. It is capable of destroying or neutralizing enemy offensive nuclear weapons, armored equipment, artillery, mortars, antitank weapons, air defense weapons, personnel, command and control facilities, and logistic support entities; laying smoke screens; performing remote mining and terrain illumination; and taking an active part in deep effective engagement of the enemy. This explains the unremitting attention which the Army command devotes to field artillery with respect to its most effective employment in modern combat.

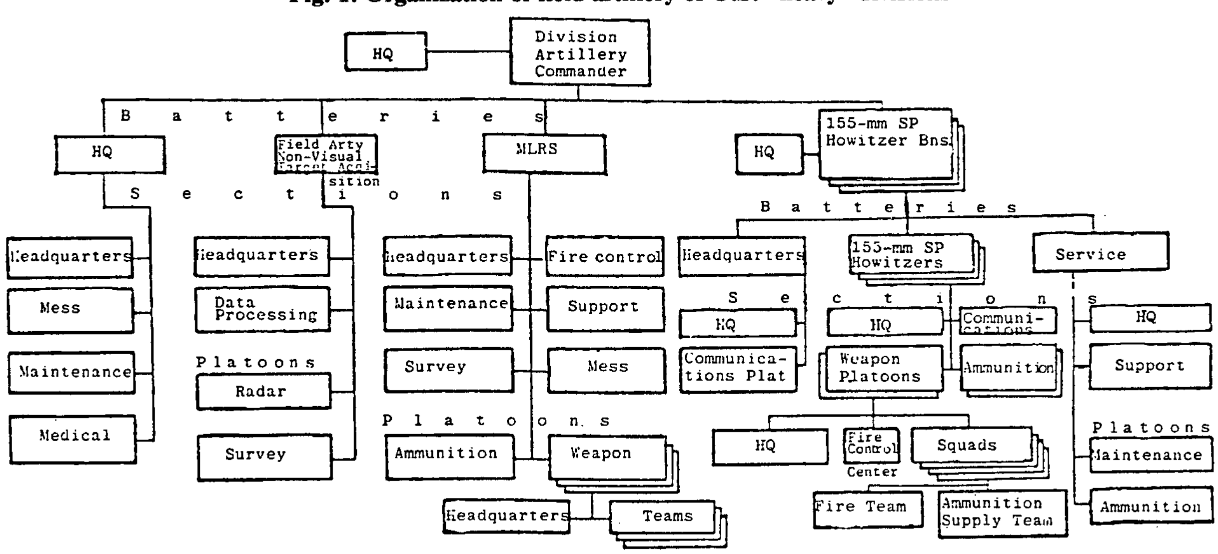
Field artillery is one of the main combat arms and includes units and subunits of intermediate-range ballistic missiles,[1], operational-tactical missiles, multiple-launch rocket systems, and self-propelled [SP] and towed howitzers. U.S. military specialists consider mortars to be organic weapons of combined-arms units and subunits and therefore they are not included in field artillery.[2]

The foreign press reports that the Army command plans to complete the Army-90 program by the mid-1990's. This program provides for improving all combat arms, including field artillery, with the objective of further increasing their combat capabilities. Measures being taken at the present time are connected to a considerable extent with changes in the organization and composition of forces and assets and in fundamentals of field artillery combat employment in "heavy" mechanized and armored divisions of the Army (U.S. regulations note that field artillery accomplishes various fire missions in the interests of these large units). The basic changes include outfitting artillery units and subunits of "heavy" large units with new and modernized weapons and military equipment (such as the MLRS, the M992 armored ammunition support vehicle, and so on), increasing the number of 155-mm SP howitzers from 18 to 24 by shifting battalions to an eight-gun battery makeup (instead of the previous six-gun makeup), removing a battalion of 203.2-mm SP howitzers from division artillery,[3] and deploying an MLRS battery as part of the artillery of "heavy" divisions.

At the present time field artillery of "heavy" large units organizationally includes a headquarters, three batteries (headquarters, field artillery non-visual target acquisition, and MLRS) and three battalions of 155-mm SP howitzers. The artillery officer (a colonel) exercises overall direction of fire support to division units and subunits through his subordinate staff (Fig. 1).

The **headquarters** (150 persons) plans, controls and coordinates the fire of organic and attached artillery and organizes all kinds of combat and logistic support. It has five sections (headquarters, coordination, two weather support sections, and an administrative-supply section), division artillery fire control center, fire support coordination team, and two platoons (survey and communications). The fire control center controls the fire of all artillery units and subunits. It includes a headquarters and three sections (operations planning, reconnaissance

Fig. 1. Organization of field artillery of U.S. "heavy" divisions



and target designation, and fire control). The center is accommodated in four vehicles: one is used for deploying the operations planning section, another for deploying the reconnaissance and target designation section, and the others for the field artillery fire control section using TACFIRE automated control system gear. The fire support coordination team coordinates fire support, fills requests for additional fire support, and determines requirements for field artillery weapons with consideration of the changing situation. The survey platoon, which includes a headquarters and three survey sections, ties in artillery fire control entities to the terrain. The communications platoon serves for organizing communications among the division artillery headquarters and the field artillery non-visual target acquisition battery, organic and attached artillery units and subunits, as well as higher echelons. It has a headquarters and six sections (one wire section and five radio communications sections).

The **headquarters battery** (37 persons) is responsible for logistic support of division artillery headquarters subunits and includes four sections.

The **field artillery non-visual target acquisition battery** (95 persons) detects enemy weapons in the division area of responsibility, processes data, and issues data to the division artillery fire control center. These missions are accomplished by fixing moving targets and firing positions of artillery pieces and mortars using radar. The battery includes two sections (headquarters and data processing) and two platoons. The radar platoon has a headquarters and six sections (a moving target acquisition section, three countermortar sections, and two counterbattery sections). The survey platoon includes a headquarters and two survey sections.

The **MLRS battery** (131 persons) provides general fire support in division interests. Organizationally it consists of six sections and four platoons. During combat operations the fire control section deploys as the battery fire control center. Each weapon platoon has a headquarters and three teams (each with one SP MLRS launcher).

The MLRS (Fig. 2 [figure not reproduced]), which became operational with the U.S. Army in 1981, is an SP launcher mounted on the tracked chassis of the M2 Bradley infantry fighting vehicle. Free-flight rockets are launched from two transport-launch containers each with six launch tubes loaded at the plant. The U.S. military press reports that an area of around 25,000 m^2 can be covered (rockets with shaped-charge/fragmentation warheads) or a minefield laid in a 1,000x400 m area (336 antitank mines) by a launcher volley (12 free-flight rockets). The MLRS reload (container replacement) time is 5-6 minutes, maximum range of fire is 30-40 km, range of travel is 500 km, and maximum speed is around 65 km/hr. The MLRS has systems for automatic guidance to the target by commands from the fire control console.

The **155-mm SP howitzer battalion** (687 persons) as a rule is attached to a brigade and provides close fire support to its battalions. Organizationally it includes a headquarters and five batteries (headquarters battery, three weapon batteries, and a service battery).

The *headquarters* controls the battalion's organic subunits in combat and provides them with combat and logistic support. In peacetime it plans and conducts combat training, personnel registration, and logistic support of battalion subunits. The headquarters has two platoons (operational-reconnaissance and survey), a fire support coordination team, an administrative and personnel records team, and a medical section. The operational-reconnaissance platoon controls the fire of organic pieces and collects and processes data on enemy weapons in the battalion area of responsibility. It consists of a headquarters and two sections (operations and fire control, and reconnaissance), which are the basis for battalion fire control center deployment. The survey platoon, which ties in the battalion's weapon subunits to the terrain, includes a headquarters and three survey sections. The fire support coordination team performs missions of coordinating fire support among the fire control center, organic artillery subunits and combined-arms units and subunits (brigade, battalions and companies). The makeup of the fire support coordination team in the mechanized and armored divisions varies. For example, in the 155-mm SP howitzer battalion which is part of a mechanized division's field artillery, this team has a headquarters, brigade fire support coordination section, three battalion task force fire support coordination sections, eight mechanized company fire support coordination teams, four tank company fire support coordination teams and three observation teams. The makeup of the fire support coordination team differs in the armored division in the fact that it has eight tank company fire support coordination teams and four mechanized company fire support coordination teams. The fire support coordination teams are attached to supported companies and provide coordination of fire support to their operations. In the course of combat operations they organize battlefield surveillance, communications with assigned fire support weapons and constant coordination with them. The fire support coordination teams have a headquarters group (four persons) accommodated in an M981 forward artillery observer armored vehicle (see color insert [color insert not reproduced]), which has been supplied to the troops since 1982. Created on the basis of a tracked chassis, the vehicle represents a mobile fire support coordination point outfitted with radio communications, laser target illumination, and fire control equipment. It has a range of 480 km, maximum speed of 65 km/hr, and a team of four persons (commander, driver and two operators).

The *headquarters battery* basically provides communications for the battalion staff with organic weapon subunits, division artillery staff, and supporting units or

subunits. It includes a headquarters section and a communications platoon consisting of a headquarters and two sections (radio communications and wire communications sections).

The *155-mm SP howitzer battery* (115 persons), which performs missions of close support to brigade first echelon subunits, includes four sections and two weapon platoons (each with a headquarters, fire control center and four squads). A squad (there are ten of them) includes a weapon team, which has an M109A2 155-mm SP howitzer (Fig. 3 [figure not reproduced]), and an ammunition supply team equipped with an M992 armored ammunition support vehicle (Fig. 4 [figure not reproduced]). The squad includes a Dragon portable ATGM system. The ammunition supply section, which provides a weapon platoon with ammunition, has four servicemen and two 10-ton HEMTT trucks. The battery has a total of eight 155-mm SP howitzers, eight M992 vehicles, a Dragon ATGM system, eight M203 40-mm rifle grenade launchers, 17 M2HB 12.7-mm machineguns, five M60 7.62-mm machineguns, 127 M16A1 automatic rifles and one 11.43-mm pistol.

The M109A2 155-mm SP howitzer, which is an improved version of the M109 howitzer, has been in the inventory since 1979. It was created on the basis of a tracked chassis and has a turret with a 360° traverse. The maximum range of fire with a conventional round is 22 km and with a rocket-assisted projectile it is 30 km; the rate of fire is 3 rounds per minute; range is 350 km; and maximum speed is 56 km/hr. An M2HB 12.7-mm machinegun is mounted on the turret. Ammunition carried includes 36 rounds (including two M712 Copperhead rounds), 500 cartridges for the machinegun and 12 hand grenades. The howitzer has a team of six persons (commander, driver, gunner, assistant gunner, and two loaders).

The *service battery* (134 persons) handles problems of keeping battalion combat equipment serviceable and providing the weapon batteries with artillery ammunition. The battery includes two sections and two platoons. The repair platoon performs maintenance and restores all battalion wheeled and tracked equipment; it consists of a headquarters, six repair sections and a spare parts section. The ammunition supply platoon has a headquarters and two ammunition supply sections (each with ten persons and five 10-ton HEMTT vehicles). It transports the reserve on wheels of battalion artillery rounds.

The battalion has a total of 24 guns, 24 M992 armored ammunition support vehicles, 12 M981 forward artillery observer armored vehicles, 24 Dragon ATGM systems, 10 M113A3 APC's, 13 M578 command and staff vehicles, 90 various vehicles, and 88 radios. On the whole field artillery subunits of a "heavy" division have over 2,470 persons, 72 howitzers, 72 M992 armored ammunition support vehicles, 36 M981 forward artillery observer armored vehicles, 9 MLRS, 72 Dragon ATGM systems, 45 M113A3 APC's, 42 M578 command and staff vehicles, more than 450 various vehicles and up to 720 radios.

The U.S. military press reports that in accordance with the accepted "air-land operation (battle)" concept the Army command views the **employment of field artillery** as a component part of deep effective engagement of the enemy. It is noted here that the MLRS and 155-mm SP howitzers capable of employing various types of ammunition are the basic means for accomplishing this in "heavy" divisions.

According to views of foreign military specialists, the MLRS battery performs general support missions in the division's interests and in some cases also reinforces the general support of brigades and battalions operating on the main axis. Battalions of 155-mm SP howitzers are the primary means of accomplishing fire missions in the effective engagement zone of first echelon brigades. At the same time they also can be used to deliver strikes in the division's interests. Rocket launchers are to be employed at platoon strength, and howitzers by battery. It is recommended assigning firing positions as close to the FEBA as possible so that weapons have an opportunity to conduct fire to the maximum range. For example, their optimum distance from the FEBA can be up to 4 km in an offensive and 4-6 km in the defense for cannon artillery and 5-15 km for rocket launchers.

The combat formation of subunits is aligned to ensure effective engagement of enemy targets, reliable fire control, and maneuver of weapons laterally and in depth. For example, it can be as follows for a howitzer battery. The battery deploys at the firing position by platoon. The platoon occupies a terrain sector up to 400 m wide, with the distance between platoons being 400-1,600 m. Howitzers can be disposed in a line or in an echelon right or left. In the latter case depth of the platoon's combat formation alignment reaches 200 m. The entire battery is accommodated in a terrain sector of from 1,200 to 2,400 m wide and 300-600 m deep. In addition to main firing positions, batteries prepare at least one alternate position, and temporary firing positions if necessary. The U.S. military press notes that a change of positions must not disrupt fire support continuity.

The presence of modern data processing equipment in weapon subunits can support preparation of initial data for each gun and launcher separately. In the opinion of western specialists, this will permit disposing guns on the terrain in a dispersed manner and accomplishing a maneuver of fire.

Battalions of 155-mm SP howitzers and the MLRS battery will deploy at firing positions by battery, by platoon, and under certain conditions by separate launchers. Platoons can change positions independently and not as part of batteries, as was previously the case, which permits reducing to a few minutes the time taken to occupy a firing position, conduct fire or launch, and leave the position.

As the U.S. military press emphasizes, division artillery combat operations will be characterized by rapid occupation of firing positions, opening of fire and changing of positions with wide dispersal of launchers and SP howitzers. Fire and strikes against individual important targets by battery, platoon or even individual launchers are to be employed more and more widely.

In considering the involvement of field artillery in effective engagement of the enemy during a friendly troop offensive, U.S. Army experts single out four periods during which it is used to accomplish fire missions: artillery support of a troop advance and deployment, preparation fire for the assault, artillery support of the assault, and close support of the offensive.

Division artillery is used partially for accomplishing missions of the first period, primarily by employing the MLRS in delivering a fire assault on the enemy.

Massive strikes by organic and attached weapons are the basis of preparation fire for the assault. U.S. regulations emphasize that continuous fire is envisaged during this time and periods of lull are allowed only when transferring fire from one target to another; there must be no more than one minute for 155-mm guns and up to two minutes for rocket launchers. Fire is shifted into the depth of the enemy defense when division first echelon brigades arrive at the final coordination line.

During the third period field artillery is assigned missions of creating conditions for a swift assault by first echelon subunits by destroying, neutralizing or suppressing targets capable of hampering execution of assigned missions.

Close artillery support of the offensive is the final period of artillery engagement, during which field artillery will support advancing forces by fire and maneuver. At this time its weapons are to be employed for the combined-arms formations' execution of such missions as exploitation of success by second echelons, repelling counterattacks and counterthrusts, making an assault crossing of water obstacles, consolidating on captured lines and others. Close artillery support of advancing brigades is planned to be accomplished by battalions whose SP howitzers are capable of advancing directly behind their combat formations and firing from short halts. Although the brigade is assigned one battalion of 155-mm SP howitzers for direct support, U.S. regulations provide that in some cases it can be reinforced by one other battalion as well as by an MLRS platoon when operating on the main axis.

On defense field artillery usually executes fire missions in the interests of the defending division first echelon units and for simultaneous deep effective engagement of advancing enemy second echelons or reserves. On defense the artillery of "heavy" divisions will accomplish the following primary missions: disrupt enemy forces and neutralize enemy weapons; disrupt or delay the enemy's organized launching of an offensive; neutralize enemy command and control, reconnaissance, surveillance and air defense assets; engage enemy troop combat formations during his offensive; prevent an attack on the enemy's chosen axis, and so on.

The U.S. military press notes that organic field artillery weapons of "heavy" divisions are to be employed basically in a centralized manner on defense. At the same time their allocation among first echelon brigades and subunits of screening forces is not precluded. Division artillery takes part in deep effective engagement conducted by the corps, provides general support for combined-arms formations, and partially is assigned to general outposts. Artillery firing positions are echeloned to ensure conduct of fire ahead of the FEBA by all weapon subunits as well as to ensure flexibility and continuity of fire support to defending units and subunits.

On the whole the U.S. Army command believes that the existing organization of field artillery subunits of "heavy" divisions and their armament permit them to execute troop combat support missions under present combat conditions.

Footnotes

1. In accordance with the Treaty between the USSR and United States on eliminating intermediate and lesser range missiles, Pershing II missiles must be destroyed by the middle of 1991—Ed.

2. The mechanized (armored) division has 66 106.7-mm SP mortars (six each in the mechanized battalion and tank battalion as well as in the army aviation brigade)—Ed.

3. All 203.2-mm SP howitzer battalions will be part of army corps field artillery brigades—Ed.

Italian Army Reserve Brigades

904Q0003D Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) p 25

[Article by Lt Col V. Pechorov]

[Text] In order to improve combat readiness of large and small units and effectiveness of command and control, the Italian Armed Forces command elaborated an Army reorganization program in the mid-1980's and began implementing it in 1987. Its realization already has led to elimination of the division structure, and the system of training Army reserve components also is undergoing certain changes.

The foreign press emphasizes that military budget limitations as well as a demographic crisis do not allow the country to maintain the number of large and small units necessary for completely carrying out missions assigned it within the NATO framework. For example, according to estimates by Italian military specialists, this requires a

minimum of 27 separate brigades. In reality, however, there are 24 of them in the Army: four motorized, ten mechanized, four armored, five alpine and one airborne. The foreign military press points out that it is this discrepancy between missions and capabilities above all that forced the Italian military leadership to revise views on a more optimum use of reserve components.

Taking the so-called French model of forming large light infantry units of territorial defense forces as the basis, the Army command decided to create three separate brigades in addition to existing ones based on three military combat arms schools and the separate reserve training battalions (alpine, mechanized and armored) stationed in Aosta, Cesano, and Caserta included in the schools. These brigades were given the following designations: alpine—Piemonte, mechanized—Lazio, armored—Puglia. When the brigades are formed, school heads are appointed as their commanders. In case of emergency circumstances as well as for the period of exercises, the subunits which those brigades lack are formed and brought up to strength by a call-up of reservists who already have served 12 months of active duty and are in the reserve until reaching the age of 45. Weapons and military equipment necessary for activating these subunits are stockpiled in special storage facilities under the jurisdiction of the command authorities of military zones and districts.

According to foreign military press announcements, up to seven days are given for activating the three separate brigades. In this regard the Army command is revising the personnel training program toward a further intensification. As early as last year its basic provisions were tested in an Army exercise held in the Northwestern Military District under the codename Aosta-88, with the Piemonte Separate Alpine Brigade taking part. Foreign press commentary emphasized that during the exercise the brigade rehearsed the organization and conduct of combat operations in addition to mobilization matters. Attention was directed to the absence of an antitank company in the brigade (in contrast to similar alpine brigades of the regular forces).

Results of the largest mobilization exercise since 1960 are evaluated positively by the western military press. It demonstrated the readiness of newly activated brigades (with those taking part in the exercise used as the example) to conduct combat operations under the rigid time constraints specified by the command authority. The exercise director, commander of the Northwestern Military District, highlighted the fact that 90 percent of the almost 3,000 mobilized reservists arrived in the barracks on time and demonstrated rather good training; he also noted the relatively high level of teamwork of the newly activated subunits.

Subsequently, heeding the NATO leadership's demands for a constant improvement in national reservist training systems, the Army command intends to significantly step up work in this direction. This is shown by the establishment of special directorates in each of the country's seven military districts to handle problems of training reserve components for the Armed Forces.

French Armored Equipment

904Q0003E Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) pp 26-32

[Article by Lt Col A. Miroshnikov]

[Text] France is one of the highly developed capitalist countries. Its Army is outfitted with weapons and combat equipment of French development and production. The development and upgrading of tanks and other armored combat vehicles follows two main directions—modernization of models previously produced and in the inventory, and creation of new vehicles. A large amount of armored equipment is exported to other countries and some models are developed especially for export deliveries. In creating armored equipment, primary attention is given to such combat features as firepower and mobility.

The prototype of a new tank designated the Leclerc (Fig. 1 [figure not reproduced]) presently is undergoing tests in France. It can be placed with western tanks of the third postwar generation according to the level of its combat attributes. The U.S. M1 Abrams and West German Leopard 2 which became operational almost ten years ago belong fully to this generation. The beginning of series production of the Leclerc tank is planned for late 1991. It is planned to put out a total of around 1,400.

The Leclerc has a classic configuration, with the driving compartment in the forward part of the hull, turret in the center and engine and transmission compartment in the rear. The crew is protected by composite armor using ceramic materials and multilayered steel armor made of layers of differing toughness and hardness.

The French 120-mm smoothbore gun (52 caliber barrel length) is used as the main armament. It can fire various types of projectiles, including fin-stabilized armor-piercing discarding sabot [APDS] (muzzle velocity 1,750 m/sec) and multipurpose (1,170 m/sec). West German 120-mm rounds which are part of the Leopard 2 tank's basic load also can be used for firing this gun. A turret recess contains an automatic belt loader for the gun designed for 22 rounds. The remaining 18 rounds of the basic load are accommodated in the front right part of the hull. Turret rotation and gunlaying drives are electric. Use of the autoloader permitted cutting the crew by one person and reducing the turret silhouette. A 12.7-mm machinegun (basic load 800 rounds) is coaxial with the gun and a 7.62-mm antiaircraft machinegun (2,000 rounds) is mounted on the turret roof plate. Smoke grenade launchers are mounted in the front part of the turret.

The fire control system includes an electronic ballistic computer, television and infrared cameras, and stabilized sights for the commander and gunner with built-in laser rangefinders.

The foreign press notes that the Leclerc tank has used a large amount of varied electronics connected to a digital data bus which provides for a continuous exchange of data among electronic units and automatic restructuring of the entire system in case of the failure or partial damage of any of its assemblies. It is reported that the cost of electronics can be almost 50 percent of the tank's cost. The tank is equipped with a detector warning of laser illumination. In this case it is possible to lay smoke screens using the grenade launchers.

The small eight-cylinder V8X 1500 liquid-cooled diesel engine with a hyperbar-process supercharging system is distinguished by high pick-up. The relatively low exhaust gas temperature (less than 400° C) gives the tank a low level of infrared revealing signs. The turbocompressor also can be used as an auxiliary power plant (with an output of 12 hp). The engine is joined with an ESM 500 automatic transmission (providing six gears forward and two in reverse) and a cooling system in the same block, which permits replacing it in only 30 minutes.

Two types of suspension—hydropneumatic and torsion-bar—were proposed for the Leclerc. After numerous tests, preference was given to the hydropneumatic suspension (firm of Messir). The running gear includes six road wheels per side, with driving wheels in the rear. The sides are covered by antishaped-charge skirts. The tank can move over rugged terrain at a speed up to 50 km/hr and conduct continuous combat operations for 18 hours, supported by a fuel tank capacity of 1,200 liters. It is planned to install external fuel tanks on series models. Water obstacles 1.7 m deep are negotiated without preparation, and those 4 m deep are negotiated using underwater driving equipment.

The Leclerc tank is equipped with an air filtration and ventilation system and an automatic firefighting equipment system. A frequency-hopping radio operating in the 30-88 MHz band is used for communications.

The AMX-40 tank (Fig. 2 [figure not reproduced]) was developed in France especially for export deliveries. Composite armor is used in frontal projections of its hull and turret. The tank is equipped with a 120-mm smoothbore gun and coaxial 20-mm gun capable of firing against airborne targets (elevation is from -8° to +40°). A 7.62-mm antiaircraft machinegun is mounted on the commander's cupola. There are three smoke grenade launchers located on each side of the turret.

The AMX-40 is equipped with the COTAC (Conduite de Tir Automatique pour Char) fire control system. The gunner has an M581 sight and M550 laser rangefinder. An M527 gyrostabilized panoramic sight is above the commander's cupola and is used for 360° surveillance, target designation, gunlaying and firing. A television camera is fixed to the gun mantlet.

The V12X 12-cylinder diesel engine is connected with a West German ZF automatic transmission. It is also possible to install the ESM 500 transmission. It has torsion-bar suspension with six rubber-covered road wheels and four track support rollers on each side. Accommodation of two mounted tanks on the rear permits increasing the range to 850 km. A disassembled bulldozer blade is attached to the forward armor plate. It is assembled and mounted on the tank by one of the crew members.

The AMX-40 can negotiate a vertical obstacle up to 1 m high and a ditch 3.2 m wide. It can cross fords no more than 1.3 m deep without preparation, but a certain amount of preparation is required to negotiate water obstacles to 2.3 m deep. Installation of an underwater kit permits assaulting water obstacles 4 m deep.

One other French tank, the AMX-32, is intended for export. It is a further development of the AMX-30B2 tank and its main armament is the very same as for the AMX-40.

AMX-30 series tanks (some 1,300, including over 400 AMX-30B2) make up the basis of the French Army tank inventory. Their series production began in 1965 and a little more than 2,340 have been produced up to the present time. These tanks also are in the inventory of the armies of Venezuela (81), Greece (190), Spain (299), United Arab Emirates (64) and Chile (21). The Saudi Arabian Army has 290 tanks made in the AMX-30S version, intended for fighting under desert conditions. Twenty-four such vehicles have been supplied to Qatar.

The AMX-30 hull is welded from rolled armor and the turret is one piece and streamlined. The driver's place is in the front left part of the vehicle and the other three crew members are in the turret.

The tank is armed with the CN-105-F.1 105-mm rifled gun. The barrel (56 calibers long) has a magnesium alloy thermal sleeve. There is no muzzle brake or fume extractor. Gases are removed from the bore by compressed air. Nineteen ready rounds are stored in the turret recess and the other 28 are in the hull to the driver's right. The basic load includes ready-to-use shaped-charge, fragmentation-HE, smoke, and illumination rounds. It is also possible to fire rounds of the L7 British gun mounted on many tanks, including the M60 and Leopard 1 series.

A 20-mm gun is coaxial with the main gun. It can be trained in the vertical plane (up to +40°) independently of the main armament. A 12.7-mm machinegun was used in its place in the first series tanks. A 7.62-mm antiaircraft machinegun with remote control from the commander's or gunner's seat is on a ring mount on the commander's cupola. Smoke grenade launchers are located along the sides of the turret. The tank can be fully covered by a smoke screen in eight seconds by using them.

The commander's periscopic sight with infrared attachment is in the front part of the commander's cupola, and ten surveillance periscopes are located around the circumference. The commander uses a monocular rangefinder to measure distance. The gunner has day and night sights as well as two periscopic observation devices. If necessary the commander can take over control of firing.

A 12-cylinder multifuel liquid-cooled HS 110 diesel engine with turbosupercharging is installed in the AMX-30. The mechanical transmission includes an automatic centrifugal clutch with electric drive, steering mechanism, brake with hydraulic drive, planetary final drives and mechanical gearbox providing five gears forward and five in reverse. The tank is capable of moving over rugged terrain at a speed up to 40 km/hr. Installation of new fuel tanks with a capacity of 970 liters permitted bringing the range up to 600 km.

Running gear suspension is torsion-bar, with five road wheels on each side and driving wheels situated in the rear. Hydraulic shock absorbers are mounted on the first and fifth road wheels. The tracks are steel with detachable rubber pads.

The tank is equipped with an NBC protection system and automatic fire extinguishing system. It negotiates water obstacles to 1.3 m deep without preparation and has an underwater kit with snorkel mounted on the loader's hatch for an assault crossing of bodies of water to 4 m deep.

An entire family of special purpose vehicles has been created based on the AMX-30, including an armored recovery vehicle, engineer vehicle, armored vehicle launched bridge, self-propelled [SP] antiaircraft mount with twin 30-mm guns, Roland SP SAM system, 155-mm SP artillery piece, and Pluton SP tactical missile launcher.

An improved model of the tank designated the AMX-30B2 (see color insert [color insert not reproduced]) has been delivered to the troops since 1982. Its armor protection has been strengthened and a new air filtration and ventilation system has been used. It is equipped with a more modern fire control system. A television system with camera mounted to the right on the turret is used for supporting aimed fire at night to a distance up to 1,000 m. An APDS round was introduced to the gun's basic load.

The tank's mobility was improved by using a new ENC-200 hydromechanical transmission and torsion bars of improved design. The engine is a modification of the AMX-30 engine (power output 700 hp). A more powerful engine (800 hp) with new turbosuperchargers has been proposed as a variant.

Under a modernization program it is planned to bring around 700 previously produced AMX-30 tanks up to the level of AMX-30B2 tanks. A further increase in protection of both tank models will be carried out by installing sets of mounted armor.

Around 230 AMX-13 light tanks produced by the firm of Creusot-Loire since 1953 are still in the French Army inventory at the present time. Over 3,000 such tanks were produced, the bulk of which were delivered to a number of countries of Latin America, the Near East and Southeast Asia.

A feature of the AMX-13 light tank is the presence of an oscillating turret, which has a 90-mm gun installed in its upper part. Initially a 75-mm rifled gun was used. Some of them are armed with a 105-mm gun, and SS-11 ATGM launchers are mounted on some of the vehicles.

AMX-10P (Fig. 3. [figure not reproduced]) tracked amphibious infantry fighting vehicles began to become operational in French armored and mechanized regiments of armored divisions in 1973. They replace obsolete AMX-VTT M56 tracked APC's. Over 800 such IFV's have been delivered to the French Army.

A welded hull of aluminum alloy provides protection against bullets and fragments of artillery rounds. There is a hinged ramp with electric drive in the rear of the vehicle for the mounting and dismounting of an assault force. There are two hatches on the hull roof plate. An M693 20-mm automatic gun and coaxial 7.62-mm machinegun are mounted on the two-place cast turret on the right. A dual gun ammunition feed system permits the gunner to conduct fire with fragmentation-HE or armor-piercing rounds with an effective range of 1,500 m. The gun's maximum range of fire is 700 rounds per minute. Training angles are from -8° to +50°. The mounted assault force can conduct small arms fire through open hatches on the hull roof plate and through two ports in the ramp. There are no side firing ports. Two Milan ATGM launchers with ten missiles stored in the vehicle hull are installed on some AMX-10P's.

The engine and transmission compartment is located in the front right part of the hull. The Hispano-Suiza HS 115 V-8 liquid-cooled multifuel diesel engine is made in a single block with the hydromechanical transmission, which has four gears forward and one in reverse. Fuel tank capacity is 530 liters. Vehicle suspension is torsion-bar with hydraulic shock absorbers on the first and fifth road wheels. The tracks are metal with rubber-metal linking and removable rubber pads. The IFV moves afloat by churning the tracks or using water jets at a speed up to 7.2 km/hr.

The AMX-10P was the basis for creating an entire family of vehicles for various purposes. Among them is the AMX-10PC command and staff vehicle (crew of six and various communications equipment), the AMX-10 ECH recovery vehicle (crane with 6 ton hoisting capacity), and the AMX-10 SAO forward artillery observer vehicle (Atila fire control system and set of navigation equipment), HOT ATGM SP launcher (basic load 18 missiles),

SP 120-mm mortar (60 mortar rounds), and AMX-10 PAC 90 fire support vehicle (90-mm gun, basic load 30 rounds).

In 1981 the firm of Loire demonstrated a new light multipurpose tracked armored vehicle, the VPX-5000. At the present time over ten prototypes have been manufactured. The vehicle has a welded steel hull, with the engine-transmission compartment located in the right front part. It is adapted for accommodating various weapon systems including HOT or Milan ATGM launchers, a 20-mm automatic gun, or machineguns. The VPX-40M SP 120-mm mortar has been created on its basis (maximum range of fire 13 km, basic load 20 rounds).

France is placing much emphasis on creating wheeled armored combat vehicles. A considerable number of them was produced for export. The AMX-10RC (Fig. 4 [figure not reproduced]) wheeled (6x6) combat reconnaissance vehicle [CRV] which became operational with the Army in the late 1970's can be used for direct fire support of infantry subunits and for engaging enemy tanks in addition to conducting reconnaissance.

The vehicle has rather powerful armament—a 105-mm smoothbore semiautomatic gun (barrel length 48 calibers) mounted in the armored turret. It has been reported that the fin-stabilized APDS round penetrates the NATO triple tank target at a distance of 2,000 m. A 7.62-mm machinegun is coaxial with the gun and smoke grenade launchers are mounted on the sides of the rear part of the turret.

The COTAC fire control system includes a laser rangefinder and electronic ballistic computer. The gunner has the M504 telescopic sight integrated with an electronic unit for automatic input of data for fire adjustment. Fire is conducted in hours of darkness using a night vision television device (with two screens for the commander and gunner) and an infrared sight.

The majority of AMX-10RC CRV's use the very same engine as the AMX-10P IFV, but the last vehicle lots were delivered with the 6F 11 SRX 300 hp diesel engine. The engine is accommodated in the rear of the vehicle. It is connected with a four-stage gearbox combining the functions of the steering mechanism through a hydraulic torque converter. The AMX-10RC turns at various wheel rotation rates on the right and left sides. The adjustable hydropneumatic suspension permits changing road clearance from 210 to 600 mm. Tire pressure is regulated depending on soil type. Two water jets are used for moving over the water at a speed up to 7 km/hr. The vehicle is equipped with an air filtration and ventilation system and radio.

More than 270 AMX-10RC CRV's have been delivered to the French Army. Around 100 such vehicles have been purchased by Morocco.

The first ERC-90 F4 Sagaie amphibious wheeled (6x6) CRV's became operational with reconnaissance subunits of the French Army in 1984. A total of 176 were ordered, with deliveries to be completed in the current year. The vehicle basically is intended for outfitting Rapid Action Force units and is adapted for being airlifted and dropped by parachute.

The welded steel hull protects against small arms fire and shell fragments. The vehicle is armed with a 90-mm gun installed in a two-place turret. The basic load of 20 rounds includes shaped-charge and fin-stabilized APDS rounds penetrating armor up to 250 mm thick at normal impact at a distance up to 1,000 m. The fire control system includes a laser rangefinder and day and night sights. A 7.62-mm machinegun is coaxial with the gun. Smoke grenade launchers are mounted on the sides of the turret.

The engine and transmission compartment is located in the rear of the hull.

The six-cylinder carburetor engine is connected with a mechanical gearbox. Wheel suspension is independent coil-spring with telescopic hydraulic shock absorbers. The middle pair of wheels raises when moving over hard-surface roads. The tires are of the low-pressure cellular type. Movement afloat at a speed up to 9.5 km/hr is accomplished using two water jets.

Two diesel engines and an automatic transmission are installed in the EPC-90 F4 Sagaie-2 modernized version of the CRV. The gun's basic load has been increased by 13 rounds.

At the present time the VAB wheeled APC which became operational in 1974 is the primary means of transportation of French Army motorized subunits. It replaced the obsolete AMX-VTT M56 wheeled APC. A total of over 4,000 VAB APC's have been ordered for the French Army (basically in the two-axle version), of which around 2,800 already have been delivered.

The APC has a closed welded steel hull with thin armor. The driver and commander are accommodated in front. The power plant is in the middle part of the hull and behind it is the assault compartment with two hatches in the rear. There are firing ports in the hull sides for conducting small arms fire.

Although the VAB APC is armed with a 7.62-mm or 12.7-mm machinegun, a small-caliber automatic gun can be installed on it. Some 60 vehicles were made in the Mephisto SP ATGM system (Fig. 5 [figure not reproduced], basic load 12 HOT missiles).

This APC uses a six-cylinder diesel engine connected with a gearbox through a hydraulic torque converter. Wheel suspension is independent torsion-bar with hydraulic shock absorbers. Water obstacles are negotiated without preliminary preparation. Movement on the water at a speed of 7 km/hr is accomplished using two water jets.

In addition to infantry transport, the VAB APC is used for towing the 120-mm mortar and as a command and staff, ambulance, maintenance, and transport vehicle.

Production of the M11 APC began in 1987. It is intended chiefly for reconnaissance and use in the Milan SP ATGM system variant. In addition, it can be used as a communications vehicle, command and control vehicle, patrol vehicle, and ambulance.

The APC's hull is welded from steel plates 5-11 mm thick. A four-cylinder diesel engine is installed in its forward part. Front wheel suspension is coil-spring and rear wheel suspension is torsion-bar. The armament is a 7.62-mm machinegun. It is planned to supply a total of 3,000 M11 APC's for the Army, of which 2,000 will be made in the reconnaissance version.

Specifications and performance characteristics of the models of French armored equipment described above are given in the table.

Specifications and Performance Characteristics of Models of French Armored Equipment

Model Name, Year Operational	Combat Weight, Tons/Crew	Dimensions, m: Height/ Length[1]xWidth	Weapon Caliber, mm: Gun/Machine-guns	Engine Output, hp	Maximum Speed, kph/Range, km
Leclerc tank, experimental	50/3	2.3/6.6x3.3	120/7.62; 12.7	1,500	70/550
AMX-40 tank, experi-mental	43/4	2.8/6.8x3.36	120/7.62; 20	1,100	70/600
AMX-30 tank, 1963	36.4	2.85/6.6x3.1	105/7.62; 12.7	720	65/500
AMX-13 light tank, 1966	15/3	2.3/4.88x2.5	90/7.62	250	60/400
AMX-10P infantry fighting vehicle, 1973	13.8/3(8)	2.6/5.8x2.8	20/7.62	280	65/600
AMX-VTT M56 tracked APC, 1955	14/1(12)	2.4/5.7x2.7	-/7.5	250	65/400
AMX-10RC combat reconnaissance vehicle, 1978	15/4	2.2/6.3x2.8	105/7.62	280	85/800
ERC-90 F4 Sagaie combat reconnaissance vehicle, 1980	8.1/3	2.24/5.1x2.49	90/two 7.62	140	100/800
VAB wheeled APC, 1974	13/2(10)	2/5.98x2.5	-/7.62 or 12.7	235	90/1,000
AML-90 Panhard armored vehicle, 1968	5.5/3	2.1/3.7x1.97	90/7.62	90	90/600
M11 light armored vehicle, 1985	2.35/2-3	2.1/3.7x2	-[2]/7.62	95	99/530

1. Hull length given.

2. Some vehicles will be armed with the Milan ATGM system.

The foreign press notes that some French firms also are developing other models of armored equipment on an initiative basis intended primarily for export.

Joint Attack Aircraft and Helicopter Operations

904Q0003F Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) pp 33-35

[Article based on western specialists' views by Col A. Osipov]

[Text] Foreign experts believe that a primary air force mission in modern war is close air support of ground forces, i.e., ground-attack operations by aircraft against enemy targets on the battlefield and in the tactical depth. It provides for primary delivery of strikes against targets which cannot be engaged by ground forces' weapons and on whose destruction the success of combat operations depends.

Based on this, U.S. specialists pay special attention in accomplishing this mission to questions involving close air support, and particularly to rehearsing joint operating tactics of army and tactical aviation. These tactics were rehearsed in a series of tests conducted under the codename Apache Thunder[1] in the period from October 1986 through June 1987. The tests were divided into two phases. In the first (October-November 1986 at Nellis AFB, Nevada) the methodology was checked and results of joint operations of the Army Aviation AH-64A Apache helicopter (Fig. 1 [figure not reproduced]) and the USAF Tactical Aviation A-10A Thunderbolt II attack aircraft (Fig. 2 [figure not reproduced]) were evaluated in delivering a strike against a ground target

during the day, and in the second phase (at Fort Hood and at Fort Sill, Oklahoma) it was done both day and night. Over 300 sorties were flown, the result being that the tactics employed were considered effective and promising by Army and Air Force experts.

The essence of the tactics consists of coordinated operations by a helicopter and attack aircraft in striking the same target. The helicopter crew performs a target search visually or using onboard equipment and "illuminates" it with a laser rangefinder/target designator. The attack aircraft crew uses the AN/AAS-35 Pave Penny laser system, which together with other onboard electronics automatically locates and tracks a target illuminated by an external source (from a distance up to 16 km). By means of this system it can make a target approach and deliver a strike against it using ordnance with laser homing heads, and also conduct fire from the seven-barrel GAU-8/A 30-mm onboard aircraft cannon and perform bombing with conventional bombs, aiming both at the target and at an aiming-off point. The bomb release point was calculated in advance using an onboard computer based on target position data coming from the Pave Penny laser system.

The British journal FLIGHT INTERNATIONAL reports that the coordination procedure of helicopter and attack aircraft crews will be reflected in special instructions being drawn up. It is noted that in executing the mission of searching for and denoting (illuminating) the target, the helicopter retains its combat capabilities and is capable of delivering strikes both against the target itself and against elements of the local air defense system. In addition, it can be used for active and passive jamming of air defense electronic equipment in the target's vicinity and in the attack aircraft's flight route area.

In analyzing results of the flight tests, U.S. experts note the following advantages of this tactical procedure.

First of all, the aircraft's tactical capabilities are considerably expanded: the need for independent target search disappeared, but at the same time the capability of accomplishing this mission using its own onboard equipment is retained; and the mix of air-to-surface weapons is expanded by suspending guided munitions (particularly glide bombs) with laser homing heads, which in turn increased the capabilities of engaging small fixed and moving ground targets. In the opinion of U.S. Army command representatives, by using this tactical procedure A-10A attack aircraft crews will be able to deliver strikes against targets located at a distance up to 150 km from the front line.

Secondly, the attack aircraft's survivability is considerably increased, since by receiving information about the strike target from the helicopter, it can make the flight to the target using the most advantageous profile (from the standpoint of penetrating air defense) and approach it at weapon employment altitude without popping up to search for it. Using aircraft guided munitions with laser homing heads on the "fire and forget" principle, the attack aircraft delivers a strike either in a standoff mode or by being in the local air defense zone for a minimum amount of time, since immediately after launch or release it can depart from the target with the execution of a maneuver to evade antiaircraft fire, while the helicopter will be illuminating it. In addition, as already mentioned, the helicopter can jam enemy air defense system electronic equipment or deliver a strike against its most important elements in the interests of the attack aircraft's safety.

Thirdly, the precision of a strike against ground targets is improved through use of guided weapons with laser homing heads.

Fourthly, target information arrives at the aircraft's bombing-navigation indicator in real time.

At the same time, this tactical procedure also has substantial shortcomings, among which western aviation specialists include above all vulnerability of the AH-64A when local air defense weapons such as short-range mobile SAM systems are employed against it, and also the impossibility of employing munitions with laser homing heads under adverse weather conditions.

In evaluating test results, however, U.S. experts believe that on the whole such joint helicopter and attack aircraft employment tactics can substantially improve the effectiveness of air strikes when accomplishing missions of close air support to ground forces. The foreign press notes that the idea of organizing joint helicopter and attack aircraft combat operations generated great interest in military experts of other NATO bloc member countries.

Footnotes

1. USAF F-15 Eagle and F-16 Fighting Falcon tactical fighters and Marine AV-8B Harrier II attack aircraft also took part in the tests—Ed.

Equipment for Airdropping Cargo from USAF Aircraft

904Q0003G Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) pp 35-38

[Article by Col Yu. Belyayev, candidate of technical sciences]

[Text] The U.S. Armed Forces command attaches great importance to questions of airdropping various military cargoes including combat equipment, weapons, ammunition and supplies.

Much attention began to be devoted to improving airdrop equipment back during the aggressive war in Southeast Asia, and especially after establishment of the Rapid Deployment Force and the Special Operations Command.

Judging from foreign press publications, the airdrop method is essentially the only method for delivering supplies to troops operating at a great depth in the enemy rear. For example, it is believed that to support combat operations of a U.S. light infantry division, 400-700 tons of various cargoes must be delivered daily to its subunits, and with high airdrop precision.

Missions of airdropping and delivering cargoes in the U.S. Air Force is assigned to the Military Airlift Command [MAC], which has over 500 military transport aircraft in the inventory.[1] The United States has developed several systems for airdropping cargoes weighing 225-22,500 kg from altitudes of 1,500-9,000 m as applied to these aircraft, but not one of them ensures accomplishing airdrop and delivery missions under all conditions, i.e., they are not general-purpose. In the opinion of western specialists, such a path for developing airdrop equipment is more effective inasmuch as creation of a general-purpose system is essentially unrealistic. Basic U.S. cargo airdrop systems and their capabilities are examined below.

The **CDS (Container Delivery System)** is intended for airdropping up to 16 A-22 containers with an overall weight of 225-1,000 kg from C-130 (Fig. 1 [figure not reproduced]) and C-141 (see color insert [insert not reproduced]) aircraft. Containers can be dropped singly or in pairs. The CDS system includes the container and parachute system. A-22 containers are placed in two rows, usually in groups of four, in the aircraft's cargo space. Airdrop accuracy is rather high—16 containers can be dropped in a 115x35 m area from an altitude of 180 m at a speed of 210 km/hr.

The **APS (Airdrop Platform System)** supports the airdrop of different types of cargoes inasmuch as the platforms (also called pallets) impose less rigid restrictions on airdrop height and speed compared with containers. In addition, the platforms are a load-carrying structure in transporting cargoes and delivering them to the hatch during the drop, and they serve as a damper in impact with the ground. The platforms are made as modules and are put together from 1.22x2.64 m sections 6.67 cm thick made from balsa wood, with upper and lower panels of aluminum alloy. Aluminum guides 2.44, 3.66, 4.88, 6.1 or 7.32 m long are mounted at their ends to fasten cargoes to the platforms.

In addition to the platform, the APS system set includes a pilot chute, one or more main chutes, and drag chutes. Existing platforms support an airdrop of cargoes weighing from 1,140 kg (platforms 2.44 m long) to 18,120 kg (platforms 7.32 m long). Platforms with a design load of 27,180 kg and more are being tested. As a rule, cargoes are airdropped on platforms from C-130 and C-141 aircraft.

The **LAPES (Low Altitude Parachute Extraction System)** is intended for dropping cargoes weighing 1,130-15,860 kg on special platforms from C-130 aircraft from very low altitudes (1.5-3 m) at a speed of 210 km/hr. Cargoes weighing 24,920 kg were dropped during tests. The airdrop was made by single platforms or by groups joined in tandem in an area of at least 230x45 m.

Cargoes are airdropped using the LAPES system (Figs. 2 and 3 [figures not reproduced]) as follows. As the aircraft approaches the landing zone at an altitude of 60-90 m, the crew extends the landing gear at a certain line and descends to a height of approximately 3 m, maintaining a speed of 210 km/hr. The cargo hatch is opened at the calculated time and a stabilizing chute is released, which helps open the pilot chutes. The cargo platform emerges at a certain positive angle of attack (its forward part is elevated) and it decelerates in a sector around 60 m long from the point at which it hits the ground. It decelerates from the platform's friction with the ground and from aerodynamic forces of the pilot chutes.

The LAPES system is suitable for airdropping supplies and certain kinds of equipment.

The **GPES (Ground Proximity Extraction System) airdrop system with brake hook** is similar in operating principle to the LAPES system except instead of a stabilizing chute and pilot chutes it uses a brake hook that attaches to the cargo being dropped and hooks a cable on the ground. The system permits airdropping cargoes weighing up to 15,860 kg.

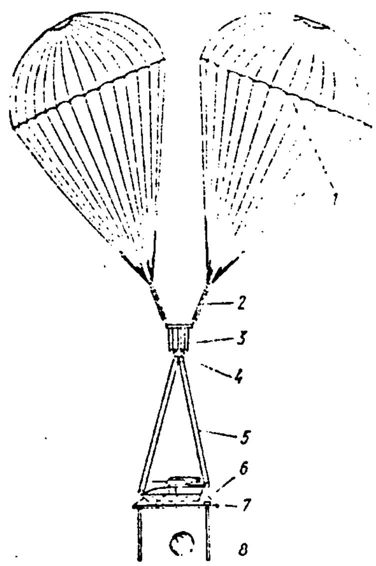
The **LADS (Low Altitude Delivery System)** supports an airdrop of cargoes weighing up to 6,800 kg from an altitude of 200 m on unprepared areas of limited size. This is done using modified G-11A cargo chutes, which permit dropping cargoes from a lesser height compared with that necessary in using the standard parachute (340 m), with a simultaneous increase in maximum load on the chute from 1,590 to 2,270 kg. Modified parachutes are used together with standard cargo platforms.

Another two systems have been developed and are undergoing tests to expand low-altitude airdrop capabilities: PRADS (Parachute Retro-Rocket Airdrop System) (Fig. 4) and EXIARP (Extraction by Inflation Aided Recovery Parachute System), in which auxiliary chutes are used to open the main chutes.

The **HLCAD (High Level Container Airdrop System)** provides for the simultaneous airdrop of several containers each weighing 680-1,000 kg from altitudes of 600-7,600 m. Airdrop accuracy (circular error probable) from an altitude of 3,000 m is 200 m.

Future airdrop systems. Foreign specialists believe that a more detailed study of factors influencing the airdrop process is necessary to create and perfect modern airdrop

Fig. 4. PRADS system with retro-rocket unit for soft cargo landing



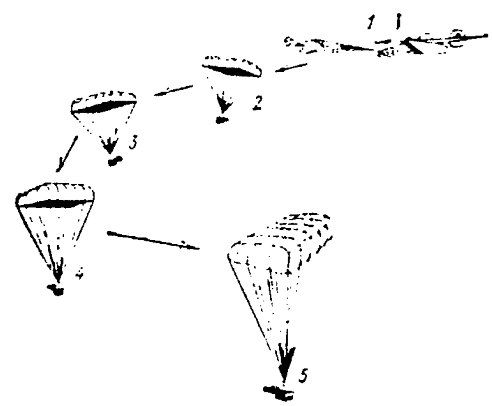
Key:
1. Parachutes with canopy 19.52 m in diameter (up to eight chutes)
2. Nylon connecting straps
3. Unit of 3-7 retro-rockets
4. Parachute release units (1-2)
5. Kevlar cargo suspension lines
6. Electronic gear
7. Cargo platform
8. Ground contact sensors (two)

equipment. It is assumed advisable to use telemetry equipment being used in space programs to accomplish this task. Parachute systems have been so improved over the last ten years that it is no longer effective to use obsolete telemetry equipment for the tests. It is believed in particular that to increase the accuracy of airdropping heavy cargoes (15-30 tons) and reduce their descent time, data are needed about forces acting on the cargoes in each phase of the airdrop process: on exiting the cargo space, in a free fall, during stabilization, deceleration, descent, deceleration before touch-down, and touch-down. The special need for modern telemetry equipment is connected with tests of new parachutes for Special Forces being carried out at Fort Bragg, North Carolina.

To ensure fulfillment of these requirements, the United States is developing the ADIS (Air Delivery Instrumentation System) for recording and transmitting telemetry to the ground. Its demonstration model is made in two 0.31x0.46x0.61 m units, one of which contains electronic gear and the other power supply batteries. Accelerometers and gyroscopes are used as sensors. The electronic gear includes eight-place analog-to-digital converters, the 80086 16-bit microprocessor, and a 1 megabyte memory. U.S. specialists believe that a 15.2x15.2x7.2 cm portable version weighing 340 g can be developed on the basis of the ADIS system.

In developing future cargo airdrop systems, including for cargoes weighing up to 30 tons, serious attention is being given to reducing parachute weight, increasing flight speeds, reducing minimum drop altitudes, increasing the effectiveness of each chute when used in systems, and using high glide-ratio parachutes and controllable cargo chutes (Figs. 5 and 6).

Fig. 5. Cargo airdrop scheme using a high glide-ratio parachute



Key:
1. Airdrop at altitude of 7,600 m
2. Chute opening at altitude of 7,000 m
3. Lateral glide of around 50 km (descent to altitude of 4,600 m)
4. Change in glide direction to 270°
5. Cargo touch-down

According to foreign press data, that is the status and development prospects of equipment for airdropping cargoes from USAF aircraft.

Footnotes

1. For more detail on military transport aircraft of the United States and other capitalist countries see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 1, 1986, pp 47-53; No 2, 1986, pp 43-50—Ed.

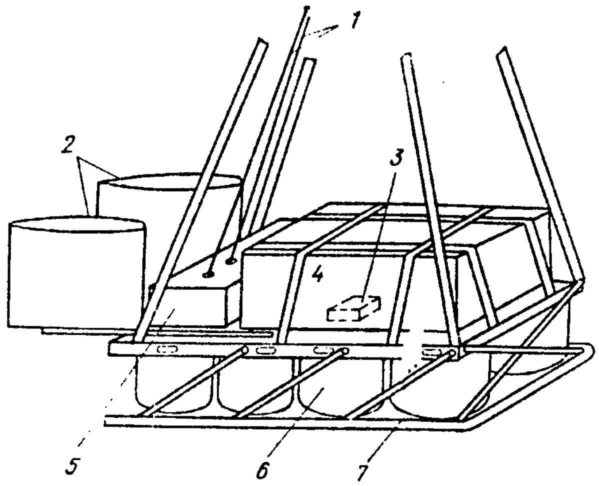
Foreign Aircraft Battle Damage Repair

904Q0003H Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) pp 38-43

[Article by Professor V. Filippov]

[Text] The command authorities of the United States and NATO countries view aircraft and helicopter battle

Fig. 6. Controllable cargo platform



Key:
1. Control lines
2. Control rudders (folding)
3. Antenna
4. Cargo
5. Control gear and drives
6. Shock absorbers
7. Pallet

damage repair as a very important factor for maintaining a high level of aviation's combat effectiveness during combat operations. The organization itself of battle damage repair is a matter of constant search for ways of coordination among aircraft manufacturing firms, supply agencies, and air units.

The basic distinction of battle damage repair methods from peacetime aircraft repair is considered to be the significant shortening of time periods for restoration work, the corresponding technology of operations, as well as conditions for performing the repair, which usually are inconvenient and sometimes also dangerous inasmuch as the repair site often is in the combat zone.

Quality performance of all battle damage repair work demands that specialists have detailed knowledge of aircraft design, inventiveness, practical skills, and proper professional qualifications. Personnel in technical subunits of aviation of the United States and NATO countries gain these qualities in the process of special training and combat training.

In addition to admitting the importance of battle damage repair, foreign specialists emphasize the limited nature of tasks pursued by this form of repair. All battle damage repair work has the purpose of restoring the fitness of a combat aircraft for a short time interval, and not for a lengthy operating period. This also determines the main feature of methods of such repair. Battle damage repair is organized in air units of the army in the field directly at base airfields, in deck-based air units of the Navy aboard aircraft carriers, and in Marine aviation at forward field airstrips. One purpose is pursued in all cases: restoration or partial repair of the aircraft in the shortest possible time to a condition permitting it to take off afterwards to execute a combat mission.

This required the development of special manuals on performing battle damage repair for each type of flying craft, and above all for aircraft of tactical aviation as the most maneuverable and most in need of this kind of repair during combat. The present level of battle damage repair methods differs considerably from the level of similar repair performed earlier, which is explained chiefly by a difference in design complexity of aircraft models. For example, during World War II aircraft would receive damages in air-to-air combat which would put them completely out of action and destroy the structure or would lead to damage which was repaired relatively easily by a simple replacement of machine units or parts.

In the late 1950's and early 1960's the predominant views on the problem of battle damage repair in NATO were that it was a secondary mission inasmuch as it was believed that an increase air defense firepower should lead to the inevitable destruction of any airborne target. It was proposed to figure the average service life of a combat aircraft to be a few dozen sorties, which essentially removed the problem of battle damage repair. The 1967 Arab-Israeli War seriously shook up these views, and the "flexible response" strategy adopted by NATO countries and an increase in the likelihood of lengthy military operations in the future strengthened the opinion on the importance of accomplishing battle damage repair missions in the course of combat operations.

At the present time the battle damage repair problem has acquired new content. The construction of modern aircraft and helicopters has become very complex; all are saturated with a large number of vital systems and battle damage to them would require a sharp increase in the amount of labor inputs for restoration. This led to increased demands for maintainability of flying craft. Performance of battle damage repair work in acceptable time periods became possible only on aircraft or helicopters having good maintainability, i.e., free access to main assemblies and machine units, the possibility of a rapid replacement of units in damaged gear, and a low level of labor inputs in all restoration processes. The validity of these provisions is confirmed by the repair of aircraft which have been damaged in flight from hitting large birds. The largest number of such cases has been registered in the process of flights made to deliver strikes against ground targets, usually accomplished at low altitudes. The repair of such aircraft drags on for months if they did not have good maintainability.

NATO specialists assume that high technical requirements must be placed on aircraft being developed both for shortening the repair periods and for the possibility

of performing on-site repair directly at airfields and at field airstrips. The 1973 Arab-Israeli War served as confirmation of the correctness of such an approach. It is assumed that had not the rapid battle damage repair methods been applied at that time, the sides' aviation would have been grounded as early as the tenth day of combat operations. Half of all aircraft damaged in this conflict were restored in 24 hours, 80 percent in 48 hours and 90 percent in 72 hours. With consideration of this experience, the UK Royal Air Force command established a wartime standard for battle damage repair of combat flying craft which specifies that 30 percent of damaged aircraft and helicopters must be restored in 12 hours after returning to the airfield and another 30 percent in 24 hours. The remaining flying craft requiring more lengthy restoration periods must be turned over to shops for repair or be sent to repair enterprises.

The rigid requirements being placed on shortening battle damage repair periods led to the need to develop special technological procedures for this work differing from peacetime repair procedures. For example, a Harrier fighter received holes in the pilot cockpit and damage to the weapon control system cable during the 1982 Anglo-Argentine conflict over the Falkland (Malvinas) Islands. The aircraft's repair would have taken several weeks under peacetime technology, but British specialists used a special procedure: they cut the damaged section out of the aircraft's side, repaired the broken cable in place and patched the repair location on the skin. All work was done in less than 24 hours.

The high density with which machine units and equipment are accommodated in the structure of modern combat flying craft increases the likelihood of serious damage to systems when hit by missile or shell fragments. Even seemingly insignificant holes from small arms produce exit holes which are five times greater in size than the entrance holes and in addition there are numerous damages to the interior structure of gear along the path of bullets and fragments. An aircraft which has taken a hit from a 27-mm to 30-mm shell will not necessarily be shot down, but it will be seriously damaged. The degree of such damage depends largely on the level of structural protection of its vital systems and their functional redundancy. The classic example of a combat aircraft designed especially with a high degree of survivability for low altitude operations over the battlefield is the U.S. A-10 Thunderbolt II attack aircraft (see color insert [insert not reproduced]).

At the same time, even an aircraft with good survivability that has been damaged in combat must be repaired in order to be ready for another combat sortie.

Repair periods depend largely on the level of maintainability of the aircraft structure, which along with assurance of survivability and reliability is constantly in the designers' field of view. But it is not only the structure's level of maintainability, but also the technological and repair methods being used that influence the speed with which an aircraft is restored.

During the aggressive war in Vietnam engineers and technical personnel of U.S. aviation were guided basically by official technological documents on repair drawn up in peacetime in support of requirements for combat readiness of aircraft with a relatively low flight intensity. As soon as the number of combat sorties rose, service personnel acted under an abbreviated technology and omitted a number of labor-intensive operations, which was not envisaged by the documents. It was then that the need arose to develop and officially adopt a scientifically grounded program of preparing combat aircraft for repeat sorties and of battle damage repair envisaging a reduction of inspections and repair work in wartime, but with strict observance of restrictions stemming from conditions of performing an upcoming specific combat mission.

Judging from foreign press reports, battle damage repair programs presently are in effect in military aviation of the United States and NATO countries which take account of an increase in complexity of aircraft and helicopter design, a forecast of possible combat operations in various theaters, and a reduction in time periods for performing repair work. The first such battle damage repair program for U.S. aviation based in Europe was developed and placed in effect in 1979. The program provided for the possibility of organizing battle damage repair work under a constant threat of enemy air strikes and with the dispersal of combat and service subunits. It was also proposed to set up special battle damage repair groups for each squadron with the mission of rapidly restoring aircraft with relatively light damage.

But restoration of aircraft which had received considerable damage and which required repair of greater complexity was assigned to specialists consolidated into Combat Logistics Support Squadron (CLSS) groups. CLSS groups in Europe are stationed at five main air bases; if necessary they can be moved to other airfields for performing very extensive repairs. An airlift from one area to another is somewhat hampered, however, due to the considerable size of the groups (up to 100 persons) and the increased amount of equipment attached to them.

Battle damage repair groups that are smaller in makeup and outfitting do not have these deficiencies. In a period of combat operations each one has a set of special tools and expendables stowed in 5-6 small containers, which are easily moved to the repair site both by ground and air transportation. Therefore battle damage repair groups, which have high readiness and the capability of rapid maneuver within a theater of operations, play the main role in rapidly restoring the majority of aircraft damaged in combat.

Rapid diagnosis of aircraft damages, calculation of requisite means for restoration, and determination of the makeup of specialists to be used for the repair is regarded as a very important function of battle damage repair groups. A damage assessment is made by special officers who receive preliminary training in general technical

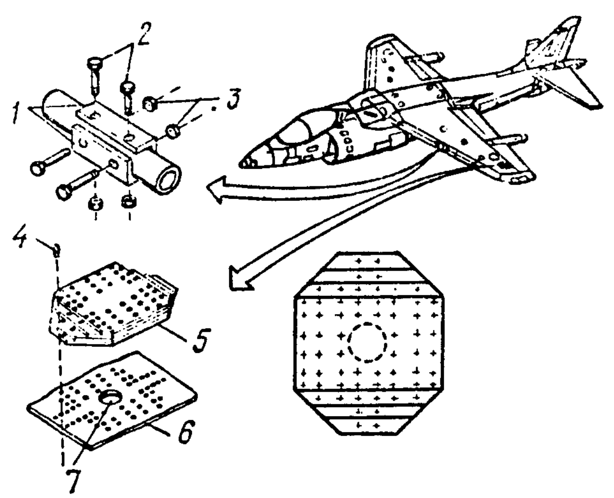
disciplines and in aircraft design, equipment and basic systems, and later in diagnostics of battle damages and restoration of the aircraft structure and machine units.

Other battle damage repair group specialists are trained as highly qualified repairmen for each specific aircraft or helicopter system. They use technical and technological repair guides and manuals drawn up by the U.S. Air Force together with industrial firms producing the corresponding equipment. With these documents, battle damage repair group personnel conduct practical peacetime training under field conditions on aircraft damaged during operation, and they are used for ordinary scheduled maintenance on aircraft in repair shops.

To perform repairs, battle damage repair groups are equipped with sets of specialized tools and devices, including in particular devices for cutting the skin and lines, installing patches, and gluing. It is believed that although such repair does not restore long-term fatigue strength, nevertheless it is fully permissible for a short-term period of combat operations. Fig. 1 is a sketch of how some types of battle damages to the AV-8B aircraft are fixed; it was drawn up by the firm of McDonnell Douglas and recommended for operating subunits.

The foreign press emphasizes that it is permissible to glue hydraulic system lines containing a pressure of up to 72 kg/cm^2. Repair by gluing gave a good account of itself in restoring many aircraft structures, including those experiencing high stresses. In a number of cases damaged components of the structure are reinforced by parts made of composite materials, especially in those places where repair using metal is impossible or hampered. Use of composite materials introduces unique problems (delamination, cracks and so on), but the advantages of such repair in speed of restoring structural strength are obvious for a short period of operation.

Fig. 1. Diagram showing how typical battle damages to the AV-8B aircraft are fixed



Key:
1. Aluminum angle pieces
2. Bolts
3. Self-locking nuts
4. Special bolts
5. Laminated aluminum patch
6. Skin
7. Cutout of damaged section

A special manual on battle damage repairs for deck-based aircraft has been developed and is in effect in U.S. Naval Aviation. It cites typical kinds of damages and methods of restoring aircraft load-bearing components, skin, assemblies and lines. At the same time a special repair kit is being made up for battle damage repairs in wartime which takes account of the features of restoring aircraft and helicopters aboard an aircraft carrier (self-contained nature, limited nature of working area, composition of specialists and so on). Such a repair kit consists of manual tools and semifinished materials which speed up the process of restoring damaged structures. The kit is accommodated in seven small containers (1.2x0.6x1.0 m in size), each of which weighs around 35 kg with contents. It is proposed that the carrier battle group will have its own battle damage repair team equipped with everything necessary and trained and prepared aboard the carrier even before deployment in a prescribed area.

The battle damage repair program for Marine aviation is adapted for use in the process of its operations from shore field airstrips. Repair kit property includes electronic equipment units, structural assemblies, landing gear wheels, as well as various semifinished items for repairs, tools, and expendables. All this along with the professional training of battle damage repair group personnel must ensure that damaged aircraft are made operational quickly.

Modern battle damage repair methods are far from perfect. For example, USAF repair specialists note that at the present time they are not yet ready to use battle damage repair methods for restoring aircraft engines, heavily damaged onboard radars, inertial systems and so on. Despite these limitations, however, it is believed that the work of battle damage repair groups will provide U.S. military aviation subunits with a considerable increase in combat capabilities by rapidly placing in operation a certain number of aircraft damaged in combat, which will be able to immediately take an active part in combat operations.

In addition to organic battle damage repair groups, logistic support squadrons which are part of the five logistic centers on U.S. territory also will be of considerable help in restoring damaged aircraft. These squadrons are manned by specialists with high qualifications as repairmen of various profiles. In peacetime they take part in scheduled aircraft repair at permanent air bases, where they gain necessary experience and practical skills. But their main purpose is to rapidly restore aircraft

damaged in combat or from accidents directly at field strips in a combat zone in the theater of operations.

Each squadron can form three echelons. The first echelon is the rapid aircraft battle damage repair team, which consists of 6-12 specialists who are experts in battle damage repair methods and whose mission is to rapidly restore an aircraft so that it is capable of flying one more combat sortie at the very least. The second echelon is the combat aircraft repair team, consisting of 40-60 persons and performing repairs of great extent and difficulty. The third echelon is the rapid area maintenance team, which includes 60-100 persons and performs major modifications and modernization of aircraft and extensive repairs directly at airfields.

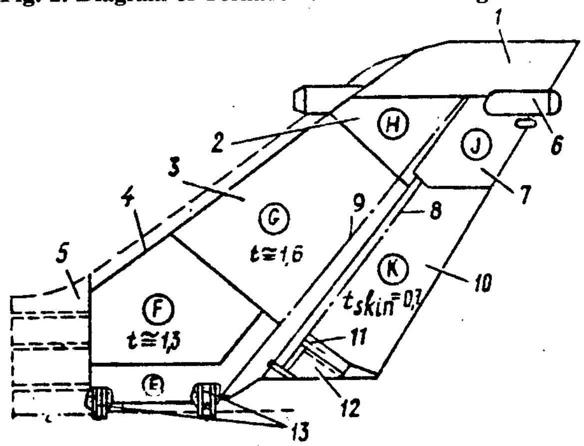
Teams are delivered to the work site by air transportation of logistic centers. These same centers also supply the teams with everything necessary. All kinds of property, spare machine units and spare parts are accounted for and delivered in the shortest possible time periods using the center's automated property system. Any machine unit or spare part is prepared for dispatch in no more than 20 minutes.

The USAF command believes that during the time of an operation all these battle damage repair teams and groups that are specially trained, outfitted with necessary equipment, tools and technical documentation applicable to each type of aircraft, and have received skills in nontraditional restoration of damaged combat equipment will be capable of rapidly placing a considerable number of aircraft and helicopters in operation, albeit for a short time, which will ensure maintaining air power in the course of combat operations. Intensive studies of the possibility of allowing an aircraft to fly a combat mission when it has structural damages of a certain level evaluated as tolerable are being conducted for these same purposes.

The work of assessing the level of permissible damage above all on new aircraft of tactical aviation is being done in NATO. For example, Great Britain is performing studies in this direction on Tornado fighters. The aircraft's entire structure has been conditionally divided into several zones in which an area is sought where damages in the form of a hole 100 mm in diameter do not reduce structural strength below a certain limit considered tolerable. It is accepted that aircraft with such damages can be released for a repeat mission in wartime without repair, although their defects exceed restrictions effective in peacetime. In each specific case the safety factor of the structure is analyzed with the true size and number of holes as well as of other damages to adjacent components of the aircraft's structure. Below is a diagram of such an analysis using damage to the tail assembly of the Tornado fighter as an example.

Fig. 2 is a sketch of the vertical tail of this aircraft with an indication of zones of possible damage, and Fig. 3 gives limitations in the location of permissible holes in the vertical tail (in zone G) with a hole diameter of 100 mm or more. Strength limitation curves are given in the chart as a function of coefficient K, which describes the lower limit of these limitations. The most rigid limitations are established at K=1, but even in this case at least 70 percent of aircraft damaged in this manner can execute a combat mission and a safe landing without any kind of repair.

Fig. 2. Diagram of Tornado vertical tail strength zones



Key:
1. Honeycomb glass-reinforced plastic
2. Double honeycomb skin
3. Load-bearing panel being evaluated
4. Front spar
5. Heat exchanger fairing
6. EW system pod
7. Tip structure
8. Hinged attachment
9. Rear spar
10. Honeycomb filler
11. Hinged attachment
12. Titanium load-bearing panel
13. Main attachment points

But any aircraft has zones and sections of the structure that are the most important and do not allow even relatively slight damage or a launch without being fixed. Special attention is given to such structures in inspections. An example of such a structure is a variable geometry wing (F-111, B-1B and Tornado aircraft), which represents an extremely important and vulnerable part of the aircraft structure. Therefore designers attempt to avoid use of such structures and introduce safer and more survivable systems and arrangements.

New NATO military standards require increased survivability of aircraft, and future ones above all, in which high-strength alloys of aluminum with lithium and composite materials will be widely used. Special measures for increasing maintainability also are provided in their construction. In creating new structures, western designers are attempting to take account of the risk of

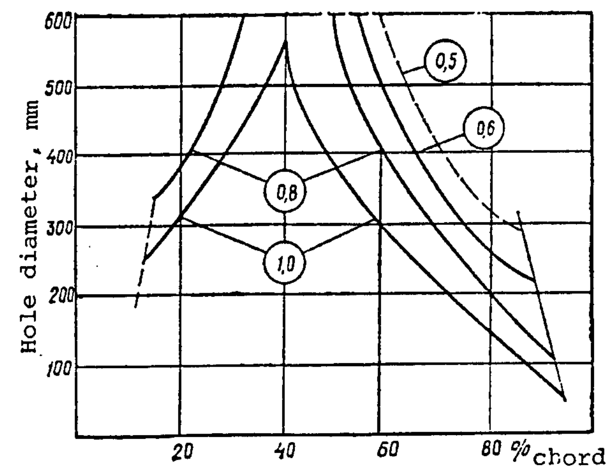


Fig. 3. Strength limitation curves for Tornado vertical tail (zone G)

possible battle damage and make them accessible for restoring strength by repairs, including by battle damage repair methods.

U.S. Surveillance and Reconnaissance Systems

904Q0003I Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) 43-45

[Article by Col V. Pavlov, candidate of military sciences]

[Text] The United States is marking the end of the 1980's with intensive efforts in developing new information systems and equipment as integral components for controlling modern weapons and for fighting in different theaters of war.

These systems and this equipment are in various stages of development. For example, the BSTS (Boost Surveillance and Tracking System) space system, intended for detecting ballistic targets in the boost phase of flight, i.e., based on exhaust flare emissions of operating motors in missile boost stages, is in the phase where equipment models are created for conducting demonstration tests and verifying the concept. The work of creating one version of an experimental satellite of the BSTS system is headed by the firm of Grumman, and work of creating another version is headed by the firm of Lockheed. A contract was concluded with them in March 1987 for a 34-month period.

Judging from foreign press announcements, the BSTS system will be a further development of a space system for detecting ballistic missile launches created in the early 1970's within the scope of the DSP (Defense Support Program). The existing system includes several satellites stationed in a fixed orbit around 36,000 km high above water areas of the Pacific, Atlantic and Indian oceans, as well as a number of ground data reception and processing points which are part of the command and control system of the joint U.S.-Canadian command for aerospace defense of the North American continent (NORAD).

At the present time the DSP program continues to be financed and developed independently of the BSTS program. It is announced in particular that the USAF command intends to procure five new satellites equipped with a dual-band infrared device and to modernize ground equipment up to March 1993.

Power consumption of power sources in the experimental satellite of the DSP system can be 5-7 kw, for which it is planned to use new solar batteries. Alternative sources including solar batteries protected against radiation and a dynamic radio isotope power unit are being considered for operational satellites (6-10 kw). It is planned to insert the experimental satellite in space from Cape Canaveral, Florida in the mid-1990's using a Titan IV launch vehicle.

The main efforts of firms in work on another space system, the SSTS (Space Surveillance and Tracking System), are concentrated on studying problems connected with creating telescope optics, mosaic arrays of detectors functioning in the long-wave portion of the infrared band, cryogenic devices, and gear for processing large volumes of data. It is assumed that detector mosaic arrays developed by Rockwell International (each matrix contains 512 detectors) can be used in creating this system. The array can be supplemented by filters made of various materials, which in the assessment of foreign specialists will permit operating in different infrared emission bands (except for the 5-8 micron band, use of which is considered inadvisable due to heavy atmospheric absorption of emissions).

It is planned to station operational satellites of the SSTS system in orbits approximately 1,000 km high with a large angle of inclination, as well as in a stationary orbit. It is proposed to launch an experimental satellite from Vandenberg AFB, California using the Titan IV launch vehicle in the mid-1990's. In the opinion of foreign experts, technical realization of the SSTS system is more complicated than in the BSTS, and its spacecraft are large, costly vehicles. It is noted, however, that even if the system is not deployed, experience accumulated in creating it will be used in other work to develop information systems.

The GSTS (Ground-Based Surveillance and Tracking System) is cheaper compared with the BSTS and SSTS systems. It is planned to accommodate its sensors on ground-launched or sea-launched sounding rockets. The firms of McDonnell Douglas and Science Applications are participating in creating the system. In July 1987 they completed a cycle of work within the scope of an 18-month contract amounting to around three million dollars. The onboard equipment of the GSTS system

sounding rocket will include a telescope, mosaic arrays of infrared detectors operating in the long-wave portion of the IR band, power source, cryogenic device, as well as a processor which with appropriate software will permit accomplishing the task of forming target designation data for future ground-based missile systems.

It was planned to conclude a contract in March 1988 for building ground equipment for this system to prepare it for flight tests. According to western press announcements, it is proposed to conduct nine sounding rocket launches during 1992-1993 from a range on Kwajalein Atoll in the Pacific Ocean; targets for them will be launched from Vandenberg AFB. In the process of the tests it is planned to evaluate possibilities of tracking up to six targets simultaneously with the GSTS system. This system will differ from the one described above by increased survivability. In addition, it will be able to detect targets at lower angles of sight and perform the task of identifying low-orbital space objects jointly with air-based electro-optical equipment being developed under the AOA (Airborne Optical Adjunct) project.

Creation of the AOA system began in 1984 and it is intended to conduct flight tests in 1989-1990, during which it is planned to evaluate its capabilities of detecting and tracking ballistic missiles of various classes in the boost, mid-course and terminal phases. The program also provides for evaluating capabilities of providing target designation for TIR ground radars and of integrated use together with space-based sensors. Some of the tests are to take place in Seattle, Washington, and others in the Hawaiian Islands and on Kwajalein Atoll.

The AOA electro-optical system includes a three-mirror telescope (Fig. 1 [figure not reproduced], the zinc selenide entrance window diameter is 58.42 cm and thickness is 3.81 cm). The base of the mirrors is made of fused quartz. A mosaic array of 38,400 detectors made of silicon with an admixture of gallium is used as a photodetector device. The detectors are configured into 15 modules, each of which contains four crystal subarrays of 640 detectors.

Inasmuch as silicon detectors are not sufficiently stable under the effect of electromagnetic pulse (as U.S. experts assume), then subsequently it is proposed to use a more radiation-resistant material in their place in the photodetector device and to use fiber-optic cables instead of electric wiring.

In monitoring the missile-space situation, signals being read from the photodetector device are converted from analog to digital form by the onboard computer system at a speed of 387 million conversions per second. In addition to the analog-to-digital converter, the system also includes a central processor and two special processors whose software is adapted both to the nature of target movement and to the background-target situation.

The task of the first specialized processor is to ensure real-time optimum signal filtration against the background of interference and false targets and to produce extrapolated target position data in order to form target designation data. Its power is 15 billion operations per second. The second processor's task is measuring target emissions, updating its movement parameters and forming target designation data. The software of this process is based on a set of standard subroutines. The central processor solves the problem of tying together paths of the entire set of tracked targets and issuing target designation data to ground equipment, particularly radars supporting the operation of intercept systems.

Studies are being conducted using sensors installed in aircraft and balloons in order to develop gear for detecting targets in the infrared band. In addition, in a number of experiments it is planned to use the Teal Ruby satellite (Fig. 2 [figure not reproduced]) equipped with an infrared detector mosaic array. It is to be inserted into orbit in 1990 using the Space Shuttle.

U.S. specialists devote much attention to creating not only passive information systems and equipment such as the BSTS, SSTS, GSTS and AOA, but also active ones including laser sets and radars. For example, during 1992-1993 it is planned to conduct an experiment to evaluate possibilities of using a lidar from aboard an aircraft.

Future components of space-based radars are being developed within the scope of the so-called "Terahertz Initiative," which has been conducted by the Air Force since 1988 in the form of a three-year research program at the basic research and exploratory development level. It is aimed at using element engineering based on the Josephson effect and superconductor engineering in transceiver devices and phased arrays. It basically consists of creating highly sensitive devices for locators operating in the 100-1,000 GHz band and ensuring receipt of target images for identification.

One concept of building a system out of such locators presumes deployment of 4-10 satellites in low circular polar orbits. Two versions of locators are considered: with lens antennas and with synthetic aperture. Tests of space-based synthetic aperture radars were conducted in 1978 using the Seasat I satellite and in 1981 and 1984 using the Space Shuttle. In the assessments of foreign experts, space locators are very costly and have low survivability. Therefore the possibility of deploying their bistatic version to improve survivability is being considered.

The United States is considering the question of creating not only autonomous information systems and equipment, but also systems accommodated together with various kinds of weapons. In particular, gear is being readied for tests of training a laser beam on a target; the gear is to be accommodated aboard the Zenith Star satellite. It is planned to install special sensors for vectoring orbital interceptors on SBI (Space-Based Interceptor) combat space platforms.

U.S. Navy Logistic Support

904Q0003J Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) pp 47-54

[Article by Capt 1st Rank A. Georgiyev]

[Text] An important role is set aside for questions of logistic support to the fleet, Naval Aviation and Marines in ocean and sea theater of operations within the scope of U.S. "forward maritime strategy" for employing naval forces in a future war. Combat operations varying in scale, spatial scope, duration and weapons used bring the Navy rear face to face with serious tasks concerning comprehensive logistic support to highly mobile fleet groupings located in various parts of the ocean at a great distance from the continental United States.

A far-flung Navy logistic system presently is deployed on the North American continent, on territories of countries allied with the United States, and in principal ocean and sea areas. Fixed (base) and mobile logistic support of the fleet, aviation and Marines is accomplished with its help.

The Navy logistic support system includes command and control entities, over 40 naval bases and basing facilities for fleet forces, around 50 air bases, six Marine bases, supply and records centers, depots and arsenals, over 130 auxiliary vessels for various purposes, and up to 200 transport aircraft and helicopters. In addition, more than 40 foreign naval and air bases; forces and assets of the civilian merchant fleet of the United States, other NATO countries and their allies; as well as transport aircraft of the USAF Military Airlift Command and civilian airline companies are used for Navy logistic support.

Navy logistic support is built on the principle of centralized control with the objective of fullest satisfaction of requirements by fleet, aviation and Marine forces for supplies both in peacetime and wartime. Centralization of control is reflected in unified direction of logistic entities within the framework of all naval forces and successive accountability of lower entities to higher ones beginning with quartermaster services of ships and logistic entities of air and ship forces and Marine divisions and ending with Department of the Navy logistic entities.

The Secretary of Defense exercises overall direction over U.S. Armed Forces logistic establishments through the Under Secretary of Defense for Research and Engineering and the Assistant Secretary of Defense (Manpower, Reserve Affairs, and Logistics). There is a logistics directorate under the Joint Chiefs of Staff which handles questions of Armed Forces logistic support in zones and in theaters of operations. The Secretary of the Navy is responsible for supplying naval forces. The Chief of Naval Operations and Commandant of the Marine Corps are directly in charge of logistic support of naval forces, Naval Aviation and the Marines through their deputies.

U.S. Navy logistic entities have two parallel forms of organization—administrative and operational. Under the administrative form, which provides for logistic support of type large strategic formations and forces, logistic entities are divided into central, fleet, and type naval force logistic entities and logistic entities of shore installations of naval and air bases and Marine bases. Operational organization of Navy logistic forces and assets permits logistic support of fleet task groups and forces as well as Marine expeditionary formations in ocean and sea theaters of operations.

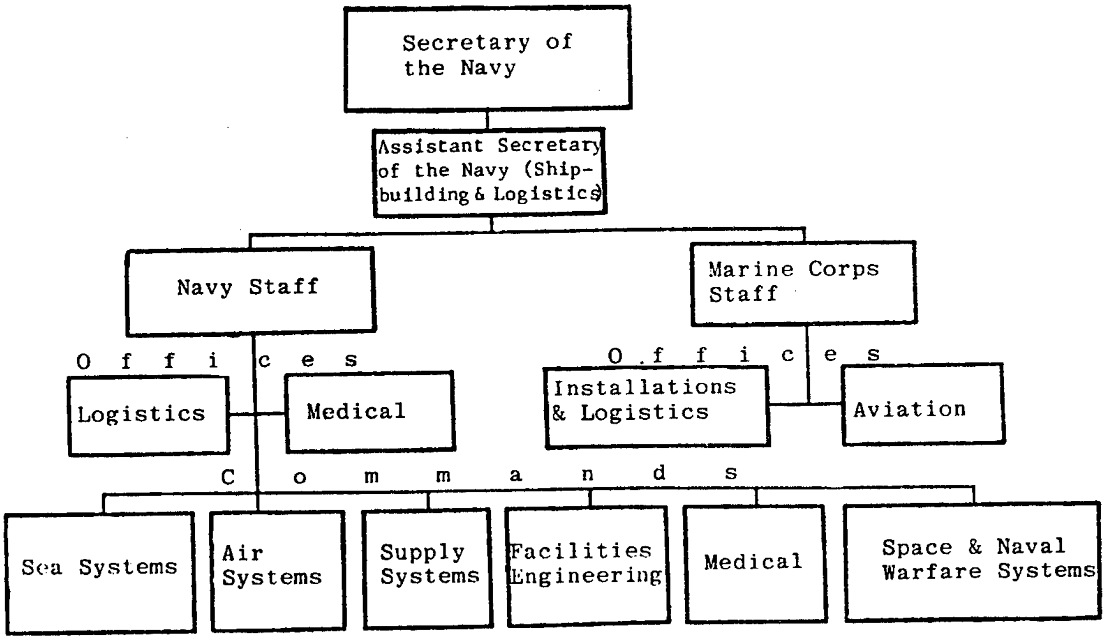
Navy central logistic entities are large military establishments which handle questions of mobilizing and using resources, coordinating the work of the military economy, and organizing joint military production and all kinds of logistic support of the fleet, Naval Aviation and Marines. In their work they closely coordinate with U.S. government establishments and state and private organizations and firms. Maintaining close coordination with firms manufacturing military products is a feature of the work of Navy central logistic entities. Each central logistic entity coordinates with those manufacturing firms producing supply items dealing with the nature of that entity's activity (aircraft, POL and so on). In this manner the Navy is provided with weapons, military equipment, ammunition, POL, food, spare parts and other supply items; military shipping and the maintenance and repair of ships and aircraft are organized; and military construction is carried out under accepted programs. According to the American command's views, the structure of Navy logistic support created in peacetime and joining military and civilian industrial installations and enterprises into a single system will permit unfolding in a short time the production of everything needed to conduct a protracted war with or without the use of mass destruction weapons.

Navy central logistic entities (Fig. 1) include the following: offices—logistics and medical; commands—sea systems, air systems, supply systems, facilities engineering, medical, space and naval warfare systems; and other offices—Marine Corps Aviation, and Marine Corps installations and logistics.

The *Logistics Office* exercises centralized direction over Navy logistic support. It determines the Navy's requirements for logistic assets and budget appropriations for logistic support, plans and participates in drawing up draft programs for weapon production and for construction of installations, coordinates questions of logistic support with U.S. allies, and directs research to improve methods and means of logistic support.

The *Medical Office* elaborates plans and programs for medical support of the Navy and directs professional

Fig. 1. U.S. Navy central logistic entities



training of medical personnel. The chief of the office (authorized category vice admiral) simultaneously heads the Medical Command.

The *Sea Systems Command* is responsible for fulfillment of shipbuilding programs and maintenance of fleet forces. It plans the construction, repair and modernization of ships and vessels, directs research activities in shipbuilding and armament, directs the search and rescue service, and monitors the technical condition of the fleet.

The *Air Systems Command* is responsible for fulfillment of programs for creating equipment for Naval and Marine Aviation and for its repair, modernization and supply; plans procurement; and directs research activities in the Naval Aviation area.

The *Supply Systems Command* directs the naval supply system, determines standards and stores of all logistic items, organizes transportation, storage and warehousing, and organizes research activity in the logistics area.

The *Facilities Engineering Command* plans and carries out construction of naval facilities (anchorages for ships and submarines, living quarters, warehouses, shelters for protection against weapons of mass destruction), keeps records of Navy Department property, and plans the use of motor transport.

The *Medical Command* organizes the work of medical centers, hospitals, and medical services of ship and units, including those of the Marines.

The *Space and Naval Warfare Systems Command* coordinates the procurement and delivery to the Navy of ground, ship and aircraft electronic equipment including command and control equipment, electronic, meteorological, navigational and space systems, EW equipment, computers and so on; directs RDT&E in naval electronic equipment development; and exercises supervision over unified standards in naval electronics.

A considerable number of various research centers, test ranges, plants, laboratories and so on situated inside and outside the continental United States are subordinate to these commands.

The *Office of Marine Corps Aviation* determines plans for construction, manpower acquisition, and logistic support of large and small Marine Corps Aviation units.

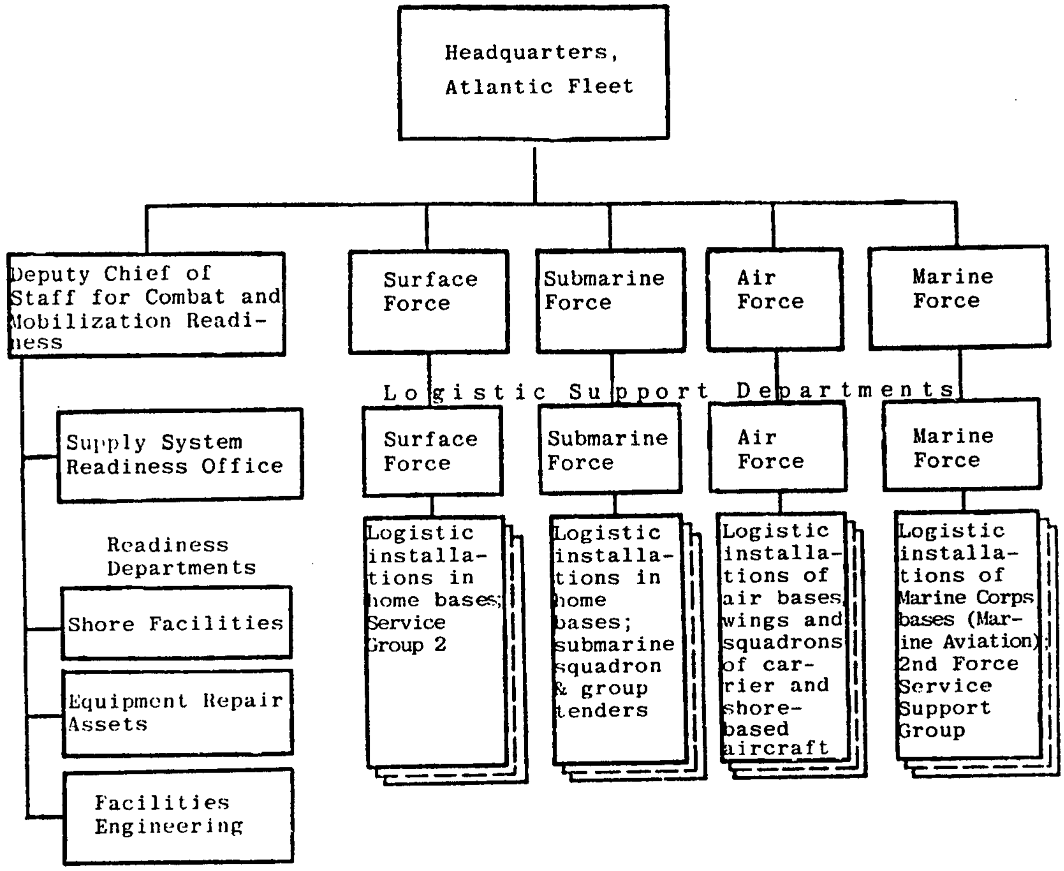
The *Office of Marine Corps Installations and Logistics* is responsible for logistic support, procurement, and construction and maintenance of installations; and plans Marine Corps mobilization deployment.

Logistic entities of fleets and type forces of the Navy differ in their makeup and structure.

Atlantic Fleet logistic entities (Fig. 2) include a supply system readiness office; departments of readiness of shore facilities, of equipment repair assets and of facilities engineering; and departments for logistic support of surface, submarine, air and fleet Marine forces. Overall direction is exercised by the Commander in Chief Atlantic Fleet through the Deputy Chief of Staff for Combat and Mobilization Readiness.

Pacific Fleet logistic entities (Fig. 3) are represented by a logistics command and by departments for logistic support of submarine, surface and air forces as well as Marine forces, which direct the activity of logistics

Fig. 2. Atlantic Fleet logistic entities



installations of type forces. All Navy installations and facilities in naval bases and basing facilities in the continental United States and beyond, including Subic Bay in the Philippines, Yokosuka and Sasebo in Japan and Guam in the Marianas are subordinate to the commander of logistics (authorized category vice admiral).

Logistic entities of the Atlantic and Pacific fleet headquarters are responsible for keeping them in constant readiness to accomplish missions as part of forward groupings, and they organize comprehensive logistic support to large and small fleet units through subordinate naval, air and Marine bases.

Logistic entities of formations of type forces are represented by headquarters logistic support departments of surface, submarine, air and Marine forces. They are responsible for logistic support of large strategic formations and large units which are formed under the operational organization.

Logistic support of surface forces is accomplished in home bases of ships and also by Pacific Fleet Service Group 1 (1st, 3rd and 5th squadrons) and Atlantic Fleet Service Group 2 (2nd, 4th and 8th squadrons). Each squadron includes 8-10 auxiliary vessels for various purposes.

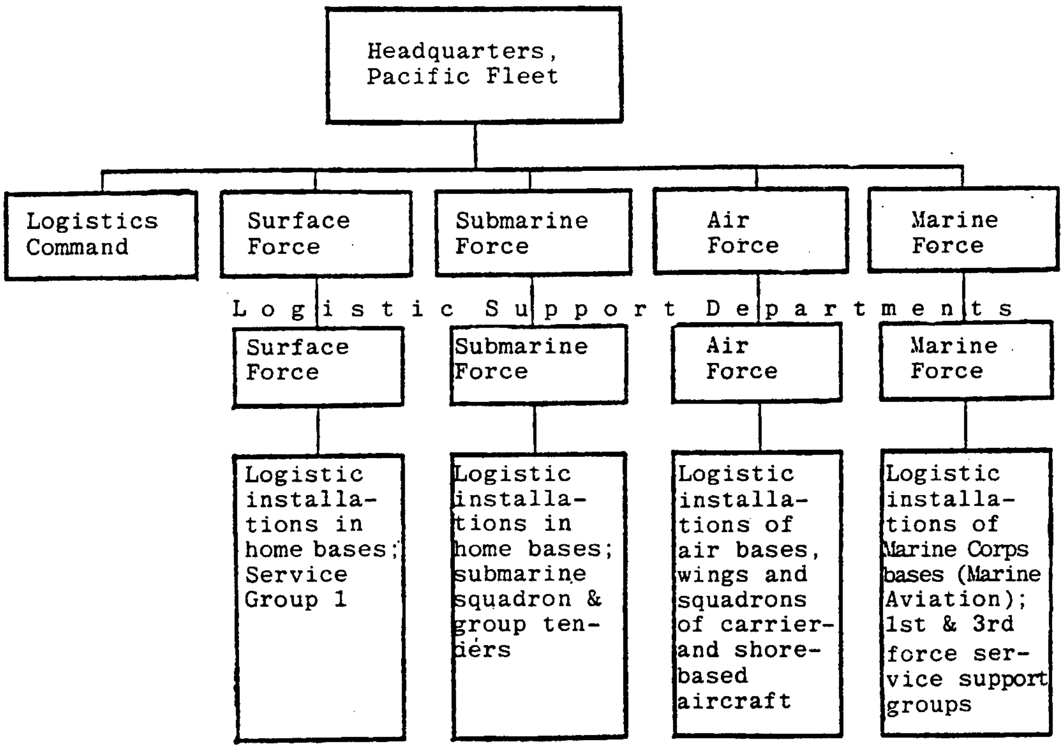
Submarines receive all kinds of logistic support at their home bases as well as from tenders assigned to Atlantic and Pacific fleet submarine squadrons and groups.

Logistic support of air forces is organized by service subunits at bases of carrier-based and shore-based patrol aviation as well as by service squadrons which are directly part of air wings.

Marine divisions and air wings receive all kinds of supply at Marine bases (Marine Aviation bases) from logistic subunits of bases and service squadrons. Expeditionary divisions include the following force service support groups (over 10,000 persons each): 1st and 3rd in the Pacific Fleet and 2nd in the Atlantic Fleet.

Headquarters of naval, air (carrier-based and shore-based aviation) and Marine (Marine Aviation) bases include authorized logistic support entities (services, departments and so on), which support day-to-day and combat activities of fleet, aviation and Marine units and subunits assigned to them. The lowest level of Navy logistic entities consists of services, squadrons, groups,

Fig. 3. Pacific Fleet logistic entities



battalions and other subunits which handle logistic matters directly aboard ships, in air wings and in the Marines.

All Navy logistic forces and assets are divided according to their nature into fixed (shore-based) and mobile (fleet logistic support at sea).

Fixed logistic support is accomplished by logistic entities in the system of naval, air and Marine bases. It provides for basing support and dispersal of fleet, air and Marine forces, comprehensive servicing and maintenance of armament and combat equipment, supply of all kinds of allowances, and preparation of auxiliary vessels for subsequent transfer to mobile service support groups of fleet task forces.

Naval, air and Marine bases are the main fixed logistic support centers both for the Navy as a whole and for individual forces, units and ships.

Administratively naval and air bases are subordinate to the Chief of Naval Operations and Marine bases to the Commandant of the Marine Corps. Operationally all bases are subordinate to commanders in chief of fleets in their areas of responsibility.

The network of bases is deeply echeloned and corresponds to naval force groupings in theaters of operations. The role of rear echelon is performed by base logistic entities and installations on the North American continent and that of forward echelon is performed by bases and basing facilities created in peacetime in the East Atlantic, Mediterranean and Western Pacific.[1]

In considering conditions for the stationing of logistic support forces and assets in the fixed basing system, the Navy command also takes into account the potential for mobilization deployment of logistic installations in ports and at airfields of the United States and its allies. Measures being carried out by the United States and NATO to create logistic holdings on foreign territories, to expand the berth capacity of ports, and to standardize weapon and military equipment systems and the repair facility attest to the Navy command's desire to achieve the most developed and ramified basing system for fleet, air and Marine forces.

Mobile logistic support forces serve as a forward element of the logistic system intended to decrease the dependence of naval forces on fixed bases to the maximum and to resolve logistic support matters directly at sea in combat areas.

Seven mobile logistic support forces can be formed in the Navy's operational organization for logistic support of fleet battle force groupings: 25th, 33rd, 63rd and 73rd are part of the Second, Third, Sixth and Seventh fleets respectively; the 85th and 87th forces are subordinate to the Commander in Chief Atlantic Fleet; and the 53rd Force is subordinate to the Commander in Chief Pacific Fleet. These forces assign mobile logistic support groups, each of which services a carrier or ship striking force. For

example, such a group supporting a Sixth Fleet carrier striking force can include a fast general-purpose supply transport, special weapons and ammunition transports (Fig. 4 [figure not reproduced]), provisions transports, several tankers, a tender and other vessels.

In addition to placing combatant ships in operation, the U.S. shipbuilding program provides for an increase in the number of auxiliary vessels. Preference in building new vessels is given to highly efficient, fast multipurpose transports and tankers with a high level of mechanization and automation of material handling operations and underway transfer of cargoes, including aviation support vessels and hospital ships.

On the whole the mobile logistic support system is oriented toward supporting the greatest possible autonomy of fleet forces in widescale, lengthy operations at sea and increasing their combat readiness and combat utilization factor. It permits dispersing stocks in sea theaters of operations, which improves the survivability of task forces.

Material support is one of the important kinds of logistic support; its status directly determines the Navy's mobilization readiness as well as its capability to conduct lengthy combat operations. The Navy's day-to-day activities and combat operations presume that the supply needs of large and small units are determined and that supplies are distributed and delivered in order to ensure a given level of combat readiness of fleet, air and Marine forces.

Supply items in the Navy are divided into six basic categories: items of consumption (food, clothing, medicines); technical supply items (gun and equipment property, electronic equipment, spare parts, testing and measuring instruments); aviation supply items; liquid products (fuel, oils, water); ammunition (missiles, torpedoes, mines, shells); and emergency rescue equipment and materials.

Navy material support is accomplished through supply centers (Norfolk, Newport, Charleston and Kings Bay in the Atlantic Fleet; San Diego, Oakland, Bremerton, Long Beach and Pearl Harbor in the Pacific Fleet); missile arsenals (Charleston, Kings Bay, Bangor); and base ammunition, armament, rations and fuel depots equipped with means for mechanizing material handling operations, automatic record-keeping, and output of data on the status of warehouse stores.

According to the U.S. press, Norfolk, Oakland and Pearl Harbor are the main aviation equipment supply centers, storing up to 400,000 record descriptions of spare parts and supply items for Navy aircraft and helicopters. Requests for receiving necessary equipment come over the AUTODIN communications system from 54 logistics automated control system terminals located at main air bases, on aircraft carriers and at the Navy's main aviation logistics center in Philadelphia, Pennsylvania. At this center computers are used to determine priority of the request, availability of required supply items, their holdings, and storage locations. Then the reply is sent over the AUTODIN communications system to the appropriate air base or aircraft carrier. Urgent requests for items whose absence directly affects aircraft combat readiness must be examined within 24 hours. The form of transportation by which it is advisable to deliver these items and the routes are determined at the same time in accordance with the precedence category of the request and the weight and dimensions of requested supply items. Cargoes are delivered to air bases located in the continental United States by ground and air transportation, and they go to forward bases by sea (scheduled requests) or air (unscheduled urgent requests) using Navy transport aircraft, the Air Force Military Airlift Command and civilian airlines.

The Navy's primary mobilization stocks are in the rear echelon at depots of the continental United States and on U.S. island territories as well as partially in Europe, Japan and the Philippines.

Operational stores are accommodated in areas of presumed employment of forces, on mobile service support vessels, and aboard ships.

In addition to mobile service support vessels, aircraft (C-130, C-118, C-1 and C-2) and helicopters (CH-53, CH-46 and UH-1) can deliver supplies to forward bases and directly to ships. They are consolidated in nine transport squadrons, five in the Atlantic and four in the Pacific.

Three squadrons of depot ships with heavy weapons, military equipment and 30 days of stocks were deployed in the Atlantic, Pacific and Indian oceans during 1986-1987 to support combat operations of three Marine expeditionary brigades (each numbering over 16,000 persons). Stockpiling of the very same stores for a fourth Marine expeditionary brigade is being completed on the territory of Norway.[2]

The U.S. Navy *technical support* system includes a set of measures aimed at ensuring combat readiness and operating reliability of military equipment and armament by performing inspections, maintenance, repair and modernization on a regular basis.

The Navy ship repair facility has great potential for repairing combatant ships and auxiliary vessels of all types. The United States has over 120 shipbuilding and ship repair enterprises belonging both to the state and to private firms.[3] Each year the repair and modernization of around 900 aircraft and helicopters, 2,400 aircraft engines, and up to 400,000 sets of electronic equipment are organized in six main aircraft repair centers. This permits maintaining a high technical readiness level (over 85 percent) of aircraft and helicopters and ensures that they are in the order of battle of Naval and Marine Aviation for 10 years or more.

In recent years the U.S. Navy command has been carrying out measures for expanding the capacity of its

forward bases and basing facilities (Subic Bay, Yokosuka, Sasebo and others) for performing all kinds of repair to fleet combatant ships to keep from returning ships to bases in the continental United States without extreme need. Ship repair enterprises in Yokosuka are being used especially actively in this connection. Major overhaul and modernization work was performed here on the carrier "Midway" in 1986.

The organization of repair of fleet surface combatants provides for repair and modernization work at three organizational levels: shipboard repair using ship personnel (preventive); using repair ships and docks (planned preventive maintenance); and repair at Navy and private yards (routine and medium repair and major overhaul). Repair of the first two levels do not require ships to be removed from the task force order of battle.

Expanded modernization and repair work has been performed on U.S. multipurpose carriers since 1976 under the SLEP (Service Life Extension Program), which permits increasing the carrier's time in the fleet order of battle by 15 years. Such work lasts up to 28 months. The carrier "Kitty Hawk" presently is undergoing repair at the Philadelphia Naval Shipyard under this program.

Technical support to the naval aircraft fleet consists of a system of inspections, maintenance, repair and modernization of aircraft, armament and equipment.

Repair and modernization of Naval Aviation are subdivided into three levels depending on the flying hours, the status of aircraft fleet equipment, and the location: organizational (daily preflight and postflight inspections and maintenance), performed directly by squadron personnel; intermediate—repair and adjustment work performed by engineer-technical personnel of an air wing or air base; and plant—medium repair, major overhaul, and modernization.

Routine repair and servicing of military equipment and armament of the Marines (tanks, guns, APC's) are performed by personnel of engineer-technical services of logistic service support groups. Major overhaul and modernization are arranged at Army enterprises.

In order to improve the Navy technical support system the number of varieties of weapon models is being reduced, programs for standardization, unification and maintainability of weapon systems and military equipment are being expanded, capabilities for intermediate-level repair and modernization are being increased, and so on. For example, GE-T-406 engines have been installed in the new V-22 Osprey VTOL aircraft which already are used in CH-53E Super Stallion helicopters and LCAC air cushion landing craft, which facilitates their repair, servicing and interchangeability directly in Marine units. The F/A-18 Hornet fighter-attack aircraft requires half the preflight servicing time of the A-7E Corsair. Engines of Harrier II attack aircraft do not require intermediate repair for 500 hours of operation, which permits using these aircraft for up to six months in Marine expeditionary battalions permanently located aboard landing ships of the U.S. Sixth and Seventh fleets.

According to a statement by former Secretary of the Navy Lehman, stores of basic supplies were established in 1987 for 13 air wings to conduct combat operations for 90 days, and the number of technically ready aircraft increased by 16 percent during 1981-1987, which is equivalent to an additional procurement of 180 aircraft.

During 1988-1989 the Navy command intends to develop a plan to almost halve the number of types of Navy weapon systems by 1995 through increased standardization and increased effectiveness of weapons.

The strong points of Navy logistic entities are the centralization of their activities, high technical outfitting, and manning by highly qualified logistic specialists.

But Navy logistic entities are experiencing considerable difficulties because of increased requirements for combat readiness of fleet, air and Marine forces under present-day conditions. In this connection the Navy command plans to carry out the following measures up to the end of the 1990's: introduce new processing equipment in order to increase promptness in passing the ever-growing volume of information connected with the decision of logistic support matters; automate labor-intensive processes and thereby reduce the number of personnel in logistic services; create new automated control systems, which will lead to an improvement in the structure of control entities of the Navy logistic support system; determine new functions and tasks for logistic centers in view of the fact that new types of ships, aircraft, weapons and military equipment are becoming operational; improve the system for delivering supplies to theaters of operations; establish new logistic centers inside and outside the continental United States; improve the table of organization structure of logistic support subunits of fleet and Marine forces assigned to the Rapid Deployment Force; and continue to build up stocks of all kinds of supplies inside and outside the continental United States.

Footnotes

1. For more details on U.S. naval bases see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 9, 1987, pp 66-74—Ed.

2. For more details on coordination of the Marine expeditionary brigade with depot ship squadrons see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 6, 1989, pp 45-54; No 7, 1989, pp 47-54—Ed.

3. Concerning the U.S. Navy ship repair facility see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 12, 1988, pp 78-88—Ed.

Status and Development Prospects of Simulators in Navies of the Principal NATO Countries

904Q0003K Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) pp 54-61

[Article by Capt 2d Rank P. Seredyushin]

[Text] The growing complexity of modern ship weapon systems and equipment; use of the latest achievements in the sphere of electronics, laser engineering and computer engineering in such systems and equipment permitting practically any data to be processed in real time; and the activation of intelligent interfaces and high-speed processing of signals from various information sources require that attendant personnel have both a higher level of education as well as appropriate skills in using their area of responsibility. This problem is urgent for specialists at all levels of the shipboard hierarchy from the ship commander and watch officer to a sonar or radar operator. Corresponding demands also are imposed in turn by the increased rate of change in the tactical situation during combat operations at sea, which is dictated by the increase in speeds, in effective range, in low signature and in surprise of employing modern weapons, by the mass employment of weapons, and by a significant reduction in reaction time needed for decisionmaking in a particular situation (with the number of situation variants also growing). Therefore preliminary training of ship specialists of different levels with the help of various simulators for working with all equipment in their area of responsibility plays a substantial role. Simulators are used at different stages of combat training missions rehearsal by ship crews; they also are used widely for monitoring and checking equipment and conducting control tests in various dangerous and extreme situations. Simulators play a substantial role in the early stage of training operators to work with gear (base training), in a period of retraining or modernization of equipment, and for increasing professional expertise. On the whole, an improved simulator system permits maintaining the personnel's professional skills in all stages of a ship's life cycle regardless of whether or not she is in the construction stage, she is in base, she has put to sea, or she has been put up for modernization.

Experience shows that training using simulators having a varying degree of sophistication makes frequent ship departures to sea for supporting crew practice optional, reduces the Navy's peacetime activity level, makes it possible to keep a lesser number of ships in higher combat readiness, increases their service life, and provides a saving of forces and assets.

One of the important positive aspects of training using simulators is the fact that they permit the operators training on them to perfect skills in manning gear without creating any kind of negative factors for the operational readiness level of a department, ship, or fleet as a whole. In addition, various tactical situations or possible equipment malfunctions can be simulated on them without any kind of risk to the physical condition of trainees. A real opportunity exists here for recreating the atmosphere of real life aboard ship (vibrations, noises, motion and so on). The simulator can be programmed for shifting from one scenario to another such as from maneuvering in a chokepoint with total restriction on visibility to conducting a search for airborne or surface targets on the high seas. Using the simulator, the instructor has an opportunity to repeat individual sequences of actions as frequently as he deems necessary as well as to slow down the time course of events to comment on individual operator actions. All this is difficult and sometimes even impossible to do aboard a real ship under deployment conditions. Although when he trains on a simulator the operator does not experience feelings of fear for his life or feelings of anxiety in a simulated situation (as can happen with his incorrect actions in a real situation), nevertheless what is essential is that trainees will have to display volitional qualities, resourcefulness, initiative and swift reaction from the very beginning, and this makes professional selection easier.

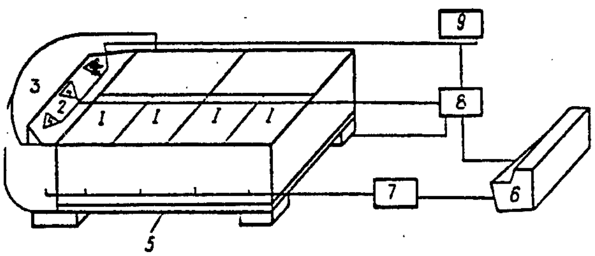
All simulators are divided into general-purpose and specialized. The former permit conducting the main training of specialists for work and actions on weapons and equipment regardless of future duty in a specific subunit. The latter provide purposeful rehearsal of combat training missions in the interests of performing functional duties aboard a specific ship and on her equipment.

Simulators can be of three main types according to the level of sophistication and number of functions practiced during training: integrated simulators, combat information center simulators, and personnel training simulators.

Integrated simulators (Fig. 1) are for rehearsing shiphandling tasks in various tactical situations, for ship maneuvering with the introduction of all possible complicating elements of the surrounding situation and navigation hazards, and for creating a need for mutual separation with passing ships. These systems give trainees an idea of what they may observe either visually or using equipment on the bridge, in the control center or in the conning tower and how the ship reacts to commands. Here the simulator instructor has an opportunity to give commands and monitor the course and results of their execution. What is happening can be brought closer to reality by installing radar and sonar screens with a simulated picture of the external situation and by presenting navigation and other information additionally.

Combat information center or conning tower simulators are equipped with synthesized displays providing an idea of the status of one's ship, the threat to her, distribution of weapons against enemy offensive weapons, conditions of weapon employment and results of their employment. These simulator systems are the most sophisticated in the nature of missions rehearsed and technical outfitting and they are also costly.

Fig. 1. Diagrammatic representation of integrated simulator



Key:
1. Booths with operator work stations
2. Bridge
3. Screen
4. Projectors
5. Hydraulic platform
6. Instructor's console
7. Controlling and simulating computer
8. Physical effects computer
9. Image generation computer

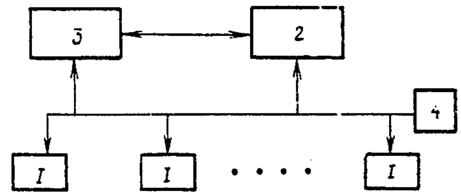
Simulators for training operators and maintenance personnel for the ship's main and reserve systems consist of systems for practicing skills in maintaining and using electronic equipment (radars; sonars; EW, COMINT and ELINT equipment; and navigation complexes and systems). This also includes simulator devices being used both in simulators of the first and second types as well as in the form of ship simulators for direct training of sonar and radar operators, and so on.

Navies of NATO countries make wide use of various simulators, from single consoles with simple monitoring and display of basic signals (questions or tasks) to those which recreate battle stations and control stations, including the control center and even the ship as a whole, at full scale with all controls, indicators, displays and other equipment.

Modern Navy simulators usually are made up of the following basic components (Fig. 2): individual operator work stations, a central computer, instructor's control console, and an interface. To this can be added elements simulating the surrounding situation, especially for simulators of the first and second types.

The operator's work station is fixed in space or fastened on a platform which can move in two or three planes. In the ideal variant it should represent an operator's automated work station with all its inherent attributes—a built-in processor, indicators, a display, a keyboard which also provides a conversational mode, and an interface for linking with other subsystems and with the entire system. At the same time it also usually is outfitted with that equipment which is in the station being simulated aboard the given class of ship, although multifunctional equipment also can be used. Gear for commercial purposes (displays, built-in processors, peripheral

Fig. 2. Standard simulator configuration



Key:
1. Operator work stations
2. Central computer
3. Instructor's console
4. Interface

devices and so on) is rather widely used, which contributes to the reduced cost of simulator systems to a considerable extent.

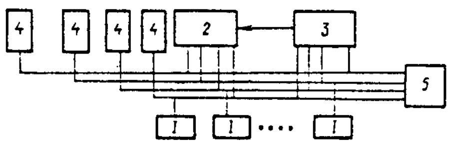
The central computer's task basically is to run various simulation programs. It also is assigned dispatcher functions in case of a large number of operator work stations, organization of functioning in a time sharing mode, storage of a large number of trainee action sequences, support of their work in a conversational mode and so on. The central computer serves for realizing computer capacities for various mathematical models represented in the scenarios being simulated. In order to use the central computer's capacity to the optimum extent, usually only a portion of the characteristics of the real shipboard equipment is simulated—those with a direct relationship to the objective of the classes.

The instructor's console, connected with operator work stations directly and through the central computer, enables him to begin the exercise, conduct it according to a previously elaborated scenario, introduce corrections and complicating elements both to the exercise and to operator actions, slow down or completely stop the development of events as the practice goes on, and also return to past events or positions. It essentially represents one of the variants of an operator's automated work station with a larger selection of controls and monitors.

A very important point in using many simulators is the possibility of a visual representation of what the operator in training should see. The most promising direction in this sphere is a combination of television engineering with computer simulation. For example, the firm of Singer Link Miles puts out the Seascope-3T simulator for practicing skills of visual observation through the periscope. Using computer simulation, it creates a television image of the situation observed through a periscope on the sea surface. It realizes the possibility of creating a picture of what is occurring above the water day or night and creating images of targets at various relative bearings and speeds and having a differing appearance due to motion and maneuvering. Simulation of the water's surface, simulation of the periscope being flooded by water, and the water's green color itself give the picture

additional reality. This simulator uses MST (Microprocessor Simulation Technology), developed by the firm, which realizes the principle of distributed processing using a local computer net in a modular configuration consisting of parallel microprocessors (Fig. 3). Television engineering also is used to create visual images (the view from the captain's bridge, the view through a periscope, possible navigation hazards and so on).

Fig. 3. Simulator based on local computer net



Key:
1. Operator work stations
2. Central computer
3. Instructor's console
4. Net processors
5. Data transfer bus

Conventional electronic equipment indicator devices are widely used to which an image can be sent from various signal simulators (radar, sonar and so on) or it can be generated by computer. Projection equipment also finds use. The Solartron SY-2094 radar simulator (Fig. 4 [figure not reproduced]), created for Navy training centers, is an example of the realization of all image creation principles. It consists of an instructor's console and radar operator's console at which radar operators, navigators and watch officers train. A graphic color display, conversational terminal, disk storage and PDP-11/73 computer are installed in the instructor's console. The trainee console permits complete simulation of a radar operator's work. One of the simulator's basic elements is a digital generator of images of surface targets, various interference, and the coastline built on a computer base and allowing highly accurate simulation of coastal objects (resolution has been taken to 15 m). The SY-2094 also simulates the work of Decca, LORAN and Omega radionavigation system receiver-indicators, radio direction-finders, and an echo sounder. A computerized video image projection system can be included in the delivered set. The instructor's console in turn is equipped with a color display showing a section of the map of a conditional training area which can be changed using a spherical knob; a separate display for depicting tables of various data; and a terminal with keyboard for conversation with the computer.

The most interesting integrated simulators were created for the French and FRG navies. In their development French specialists proceed from the fact that standard simulators must be unified for training specialists of different types and classes of ships both of national navies and those intended for sale abroad.

The Suman Naval Training Center in France uses an integrated simulator for SSBN crews during manpower acquisition and in between-deployment training of personnel of submarine control and battle stations. The center was considerably modernized in the period 1981-1984, which is connected with the refitting of French SSBN's for new M4 ballistic missiles. As a unified system, the Suman Center's integrated simulator includes five large subsystems interfaced for exchanging data and control signals using a data line. Each subsystem also can function as an independent simulator based on the 32-bit SEL-32/77 computer, supporting practice of one of five main tasks: missile firing, maneuvering in a varied tactical situation, control of the main power plant, control of the submarine, and navigation calculations. In addition, the system includes seven small simulators (based on type 15M computers), by which special missions can be practiced: maintenance of launch silos, missiles and their launch systems; repair and adjustment; work on the sonar system and classification of detected targets; use of radionavigation equipment; work on a radar; computer equipment maintenance, and so on.

The platforms where operator stations are located are fixed. An exception is a simulator for practicing submarine handling (in heading, heel, trim, and running depth), which has two degrees of freedom in the horizontal plane and simulates physical effects arising on a submarine with a change in her load (ballast) or her trim, and with water flooding the compartment. The tactical simulator includes a noise synthesizer. A new training center will become operational in France in the early 1990's. Crews of new-generation SSBN's ("Le Triomphant"-Class) will train there.

The West German firm of Krupp Atlas Elektronik created one of the most modern integrated simulators for the FRG Navy (Fig. 5 [figure not reproduced]). It realizes all functions of handling ships of any type and rationally combines simulator, research, and monitor devices. The basic component is the captain's bridge of a combatant ship (or auxiliary vessel) outfitted with all necessary external and onboard information sources, navigation radar indicators, charts, plotting boards, engine telegraph and so on. It provides for visual surveillance in a 250° sector. An instructors' room, auditorium and computer center are installed in the simulator complex. There are six separate booths in which conning towers are simulated. A special electro-hydraulic drive was created to ensure that practices are conducted under conditions approximating actual ones to the maximum. It enables recreating rolling and pitching of a ship or vessel within limits of 12°, yawing, and even deck vibration (resulting from the operation of propellers) in a fully natural manner. All this is supplemented by a noise background. From their work stations operators can give necessary commands and execute operations of shiphandling and of weapon and equipment operation independently of each other. They are performed in real time with the use of computers.

One feature of the simulator complex is the layout of the instructor's automated work station in which the latest

achievements of control and ergonomics theory are widely used. In particular, it provides for realization of a monitoring and prompting mode based on menu technology, i.e., the capability of a trainee to select the proper variant of actions by giving a number of supplementary scenario instructions and creating a "decision tree," for which the operator himself must choose the path.

Programs entered in the simulator complex central computer are capable of recreating a situation aboard seven ships of different classes, and they simulate situations of a ship maneuvering in a harbor, in a narrows or on the high seas. The effect of recreating reality is enhanced by simulating the effect of water, wind, rain and other atmospheric phenomena. Eleven color projectors which recreate the view through the control center windows are capable of simulating the silhouettes of ships of main types in a static or dynamic situation (a total of up to 60, of which 14 are in movement), in addition to depicting a day and night situation under various weather conditions. Tracking of the ships also is supported by a surveillance radar.

Events occurring in the course of practice as well as operators' reactions and actions are registered on information-carrying media in the computer, then recreated during a critique in the auditorium. In addition to the main "flagship" consoles, the integrated simulator has four additional operator work stations, which permits simulating the situation as part of a force and train in appropriate actions.

A 32-bit Gould-32/37 processor combined in a net with eight Krupp-ERP/300 processors (of which five serve for creating the image) is the central element of the FRG Mürwik Naval School simulator complex computer center. A similar integrated simulator has been supplied for the Australian Navy training center in Sidney.

One of the new directions in the sphere of creating simulators is their modular execution using multifunction consoles. This permits easily and quickly varying them in makeup and purpose for simulating and rehearsing different functions. In particular, the Seacomor general-purpose simulator of the French firm of Thomson-CSF is a model of a submarine conning tower in modular execution. Its versatility lies in the fact that it can easily be refitted for training combat information center operators and watch officers of submarines and surface combatants, and it can be used for training aircraft crews. It includes operator work stations (Fig. 6 [figure not reproduced]), a central computer and an instructor's console. Operators and the instructor have standard multifunction consoles at their disposal with graphic and alphanumeric displays, conversation support equipment, and controls. Depending on the console's purpose, the screens display a specific synthesized image, video signals, or radar and sonar signals. The task of recreating the entire situation at a particular station was not assigned in developing the simulator, and therefore equipment used for commercial purposes that is suitable according to functional purpose also is used. This permitted simulating a submarine's central station rather accurately with a significant (up to 50 percent) saving of funds.

The SY-2086 navigational-radar simulator belongs to simulators of the third type. It includes a computer subsystem of two microprocessors, which permits simulating a coastline and surface targets as well as processing data circulating in the system. It is an analog of the aforementioned SY-2094 simulator. The image generator recreates from 24 to 46 radar blips on the screen, as well as the coastline with a resolution to 30 m. The mathematical model loaded into the computer recreates up to ten targets of different types.

The MAST sonar simulator created by the firms of Elettronica San Giorgin (Italy) and Raytheon (USA) also belongs to systems of the third type and is installed in one of the Italian Navy training centers. It is a programmable, controllable microprocessor system which can be expanded right up to the simulation of various sonar signals of operating submarine and surface combatant sonars and sonobuoys. The Italian Navy uses this simulator for training DE-1160 sonar operators.

The French firm of Sogitech developed a naval simulator based on a commercial analog for practicing missions of preventing collisions at sea using a navigation radar. The simulator also can function in the mode of a large radar plotter with ARPA (Automatic Radar Plotting Aids) characteristics, displaying targets, navigational hazards, the coastline and so on. In addition, various nonstandard and critical situations can be created and specific malfunctions can be introduced on it. Such flexibility is ensured by computer simulation and control and by use of a conversational mode between instructor and operator. Up to six operators can train on the simulator simultaneously.

Simulators of various signals (radar, sonar, EW equipment and so on), which can be activated independently or together with any other simulators, also belong to simulators of the third type. In particular, NATO countries have created a special NEWSG group for solving questions involving EW problems. The group developed mobile sets by which it is possible to transmit the full gamut of electronic emissions of the probable enemy's ships and aircraft. Simulation of distortions of communication and radar signals also is provided. The mobile sets can be used both from shore and from ships. The firm of Sperry (USA) is the primary producer of such simulators.

Progress in the area of automation equipment and the creation of improved and inexpensive microprocessors, large-capacity, fast and inexpensive memories, improved operating systems, and software as a whole advanced to the forefront the idea of creating built-in simulators both in individual ship subsystems and in a unified automated combat control system. Interest in this direction also was generated by the growing complexity of modern ship weapon, situation coverage, and

control systems and subsystems and by the increased cost of specialized simulator equipment. This approach provides a saving of funds and permits training specialists almost under real conditions and maintaining and increasing their qualifications without separation from duty aboard ship. The majority of functions of a simulator built into a particular subsystem can be provided by software by the future activation and introduction of basic principles and methods of artificial intelligence (particularly expert systems). Modern shipboard automated combat control systems (such as the U.S. AN/BSY-1 and SCCS Mk 2 and the British COMKAFS) provide a training mode in the system itself. But existing trends toward a shift to distributed processing and modular structure of systems based on a local computer net, standardization of equipment, use of high-speed data lines with fiber optics, and the introduction of artificial intelligence open up the possibility of a qualitatively new approach to creating built-in simulator modules and combining hardware and software methods.

U.S. Navy specialists presently are developing two built-in simulators, one of which will be connected with the AN/SPA-256 radar and the other is intended for future "Seawolf"-Class nuclear submarines. The western press notes that submarines are ideal platforms for built-in simulators, since the crew can work on them at any time during lengthy autonomous cruises, thereby maintaining qualifications at a high level. Built-in simulator equipment provides a considerable effect especially in those areas where operators lose their skills over time. A transition to automated combat control systems in new submarines based on an integration of all the ship's electronics into a single complex with realization of the concept of distributed processing based on local computer nets will permit training and drilling not only personnel of individual stations and control centers, but also the entire crew under situational conditions essentially equal to those of a combat situation.

Built-in simulators are envisaged in the structure of ship systems of the British Solartron company which are being developed on the basis of hardware and software created by the firms of Shinmberger (UK), Fairchild (USA) and DEC (USA). Concepts of distributed data processing and local computer nets as well as of flexible adaptive structures capable of modification and reconfiguration are used here. There can be up to ten nodes in a local net performing the role of computers for simulating the situation and activating memory and controllers, joined by a fast data line. Each node is based on 32-bit single-board DEC Micro-VAX computers whose capacity corresponds to VAX-11/780 computers with considerably lesser size. Several Motorola M68000 16-bit microprocessors built into operator work terminals and performing processing functions for the entire system or for a given node at a specific terminal are connected to the nodes. This system, which was created on a modular principle, can have a total of up to 2,000 channels for passing control signals and data at a rate up to one megabyte per second. The initial data base with a capacity up to one megabyte is written on flexible magnetic disks or a Winchester disk. Developers consider the ultimate objective to be creation of an integrated simulator which can be built into ship automated combat control systems with full simulation of the surrounding situation, various tactical situations and possible malfunctions.

With activation of external communications lines, remote equipment and built-in simulators, there will be an opportunity to practice missions in the future at the level of the force or group of ships with wide use of expert systems, one version of which presently is being checked out aboard the U.S. nuclear carrier "Carl Vinson."

The foreign press states that a general trend in the development of simulators in NATO navies is the striving to provide combatant ships with highly qualified specialists and to maintain a high level of training throughout their entire period of service. Both sophisticated simulator systems on shore as well as onboard simulators are being created for this purpose. Since simulator systems are very costly, they are being created within the scope of basic national shipbuilding programs or as part of a large export order.

The following are considered to be the basic directions in development of simulators at the present time:

—Improving equipment that displays and creates a situation equal to a real situation by using television and video engineering, graphic displays and multicolor screens;

—Using microprocessor equipment based on the concept of distributed processing and a local computer net; and activating high-capacity memories permitting practices in real time and ensuring storage and recreation of game situations, integration in training not only individual operators but also crews as a whole, and simulation of any variants of tactical and critical situations;

—Supporting modeling in simulators through software, which becomes possible thanks to the use of high-capacity processors, fast data lines, high-capacity operating systems which implement parallel processing, and modern programming languages;

—Using modular designs in accordance with modern shipbuilding principles, which lends versatility to simulator systems;

—Activating multifunction consoles;

—Making wide use in shore simulators of computer and display equipment being used for commercial purposes, which permits approximately halving the cost of simulators compared with what the cost would be if using authorized equipment;

—Disseminating more and more widely simulators built into shipboard systems that provide continuity in training and improving personnel at sea and in bases;

—Creating physical effects of being at sea using shore simulators.

In the assessment of foreign specialists, principles and methods of artificial intelligence will become widespread in the future in the technology of creating and using simulators. Equipment for understanding natural language and expert systems will be of special interest; this will permit raising the flexibility of specialist training, recreating any possible situation to a greater extent, increasing the saturation of the unit of time set aside for practice, and improving the end result.

Swedish "Göteborg"-Class Missile Craft

904Q0003L Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) pp 61-62

[Article by Capt 1st Rank F. Volgin]

[Text] The missile craft K 21 "Göteborg"[1], the lead ship in a series of four, is being constructed in Sweden at the Karlskrona Varvet Shipyard. It is planned to employ them as part of ship striking forces and hunter-killer forces and to conduct minelaying, protect territorial waters and take part in search and rescue activities.

The craft's full displacement is 380 tons (standard displacement 300 tons), hull length is 57 m, beam is 8.0 m and draft is 2.0 m. She has a crew of 36-40. The hull is steel and the superstructure and lower mast are aluminum alloy. The upper part of the mast, made of glass-reinforced plastic, creates less interference to the operation of electronics than a metal structure. The hull is divided along its length into nine compartments by watertight bulkheads; the craft retains buoyancy and metacentric stability with two of them flooded. The control center, combat information center and communications station are accommodated in the central part of the lower deck.

The craft's main power plant is diesel (three MTU 16V396TB94 diesels each with an output of around 2900 hp), it operates three KaMeWa 80562-6 water-jet propellers and provides a maximum speed of 32 knots. Results of studies have shown that compared with screw propellers, water-jet propellers have less noise and give a ship greater maneuverability and safety when operating in areas with a difficult ice situation, in shallow water and in littered channels. A further drop in noise as well as an increase in impact resistance of the main power plant are achieved by using light noise-absorbing supports for the diesels and reduction gears as well as elastic couplings which transmit rotation from the engines to the water-jet pumps.

Three three-phase 285 kw diesel generators (400 volts, 60 Hz) are the primary sources of power for the missile craft. Secondary sources (converters) create three-phase current (220 volts, 60 Hz; 220 volts, 400 Hz; 115 volts, 400 Hz; 115 volts, 50/60 Hz), single-phase current (115 volts, 400 Hz) and direct current (24 volts). The diesel engines and diesel generators are accommodated in two engine rooms (compartments): two engines and one generator in the bow and one engine and two generators in the stern compartment.

According to the design, the craft's main armament (missile and torpedo) will vary depending on assigned missions. In particular, four RBS 15 twin antiship missile launchers (maximum range over 100 km) can be replaced in short time periods by four 533-mm single torpedo tubes using standard hydraulic hoisting cranes. Type 61 Mod TP613 antiship torpedoes (range of fire 18 km) are used.

Antisubmarine weapons include four 400-mm single torpedo tubes accommodated in pairs on the starboard side fore and aft. They are intended for firing new Type 43 Mod TP431 wire-guided antisubmarine torpedoes with acoustic homing in the final phase (range of fire 20 km). That placement of torpedo tubes ensures volley fire with one forward and one aft torpedo without creating interference to the operation of sonars (the S 304 Simrad keel-mounted sonar and TSM2643 Salmon variable-depth sonar). Antisubmarine weapons also include Elma depth charge launchers and traditional depth charges which can be accommodated on mine rails passing along the ship's entire hull. Depth charges or mines are dropped from them on each side at the stern.

Gun armament is represented by a Bofors Mk 2 57-mm light gun at the bow (range of fire 17 km) and Trinity 40-mm antiaircraft gun system situated behind the superstructure.[2] The entire basic load of the Bofors Mk 2 (220 rounds) is accommodated in the gun magazine, and the magazine of the Trinity system with a capacity of 100 rounds can be augmented manually from the ammunition room.

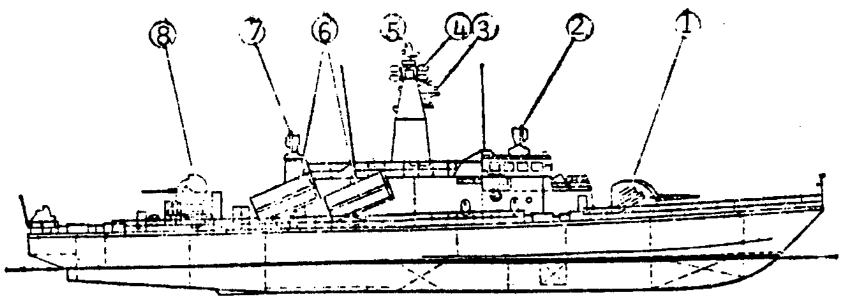
An automated combat control system provides for integrated and flexible use of the missile craft's armament and equipment under conditions of the enemy's mass employment of various attack weapons. It consolidates all air, surface and undersea situation surveillance equipment, EW equipment, missile, antisubmarine and gun weapons, and navigation and communications equipment as subsystems.

Completion of construction and the beginning of sea trials of the lead craft K 21 "Göteborg" is planned for the end of this year, with the other three craft (K 22 "Gälve," K 23 "Kalmar," K 24 "Sundsvall") to be commissioned during 1990-1991.

Footnotes

1. Some foreign publications include this class of missile craft in the corvette type—Ed.

Sketch of Swedish Navy missile craft K 21 "Göteborg"



Key:
1. Bofors Mk 2 57-mm gun
2. Antenna of 9PLV200 Mk 3 bow fire control radar
3. Antenna of PN-612 surface search radar
4. ELINT and EW equipment antennas
5. Sea Giraffe-150HC air search radar antenna
6. Twin RBS15 antiship missile launchers
7. [Not identified in caption]
8. Trinity 40-mm antiaircraft gun system

2. For more details about it see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 10, 1988, pp 61-62—Ed.

Draft U.S. Military Budget for Fiscal Years 1990 and 1991

904Q0003M Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) pp 63-68

[Article by Lt Col V. Yefremov]

[Text] A draft of the country's military budget drawn up by the Reagan administration for two fiscal years, 1990 and 1991, was submitted to the U.S. Congress for consideration in early January 1989. Appropriations for the official military budget (the federal "National Defense" program) were envisaged in the amount of $315.2 and $330.8 billion respectively (annual increments of 5.5 and 4.9 percent) and outlays at $303.0 and $314.4 billion (1.6 and 3.8 percent increments), with appropriations for the Defense Department in the amount of $305.6 and $320.9 billion (annual increments 5.3 and 5.0 percent respectively) and outlays at $293.8 and $304.7 billion (1.4 and 3.7 percent increments). In real terms the appropriations increment for the military department was evaluated at approximately 2 percent annually, and Pentagon outlays in 1990 were to decrease by 2.2 percent compared with the previous year and increase by 0.4 percent in 1991.

The relatively low planned military budget growth rates for fiscal years 1990 and 1991 were dictated above all by Reagan administration plans to balance the 1993 federal budget, which in the current year will have a deficit of over $160 billion, in the assessments of western economists.

On assuming office on 20 January 1989, new U.S. President G. Bush announced a continuation of the previous administration's budget policy on the whole. At the same time the new leadership took more cardinal steps for eliminating the federal budget deficit. For example, some of its sections for 1990 and 1991, and the Defense Department request above all, were revised.

The FY 1990 military department budget request was reduced by $10 billion in appropriations and its outlays by $4 billion, and for FY 1991 these indicators dropped by $9.9 and $6.8 billion respectively. As a result annual appropriations increases for the Defense Department in current prices will be 1.9 percent in 1990 and 1.5 percent in 1991. Outlays in 1990 will remain at the previous year's level, and in 1991 will grow by 2.8 percent. In constant prices U.S. Defense Department appropriations will drop in 1990 by 1.2 percent compared with 1989, and in 1991 the annual increase will be 2.2 percent. It is assumed that the annual drop of Pentagon outlays in 1990 will be 1 percent, and in 1991 0.4 percent.

The reduction in the Reagan administration's budget request will entail a drop in the military budget's proportion in the GNP and in the federal budget (Table 1).

Table 1—Draft U.S. Military Budgets Proposed by the Reagan (I) and Bush (II) Administrations for FY 1990 and 1991

	1990			1991		
Funds and Their Proportion in the Overall Budget	I	II	Changes	I	II	Changes
Appropriations, $ billions	315.2	305.2	-10.0	330.8	320.9	-9.9
Outlays, $ billions	303.0	299.0	-4.0	314.4	307.6	-6.8
Proportion of military budget, percent:						
—In GNP	5.4	5.4	-	5.3	5.2	-0.1
—In federal budget	26.3	26.0	-0.3	26.0	25.5	-0.5

In addition, Department of Energy military programs, the primary objective of which is the creation of nuclear weapons, Federal Emergency Management Agency (FEMA) military programs, as well as a number of other kinds of activity placed under the national classification of "military" are financed within the scope of the military budget.

In the next two years the Department of Energy is requesting $9.0 and $9.4 billion for military programs. About half of these amounts is earmarked for the development, testing and production of nuclear weapons and almost 40 percent for the production of nuclear materials and burial of radioactive wastes. Such a significant growth in appropriations (in 1990 by 11.1 percent more than the previous year) is dictated above all by the increase in funds being allocated for production of nuclear materials and burial of radioactive wastes in connection with an expansion in volumes of materials processed as well as with measures taken to improve safety and protect the environment.

It is planned to allocate over $0.3 billion to the Department of Energy for research and development under the SDI program. Of these funds, $266 million are for work in the sphere of creating directed-energy weapons, and $45 million for developing a nuclear reactor for installation in military spacecraft.

Funds are allocated for military purposes not only within the scope of the "National Defense" program, but also under a number of civilian items of the federal budget. This fact is not denied even by official representatives. For example, according to data of the Defense Information Center, a fourth of the National Aeronautics and Space Administration (NASA) budget is for realization of military space programs.

An important place in NASA's work is devoted to creating a long-term orbital station which will have an applied military purpose. In 1990 it is planned to appropriate around $2.1 billion for these purposes. It is proposed that the European Space Agency as well as Canada and Japan take part in its creation along with NASA.

The long-term orbital station will represent a multipurpose space complex with an add-on type of structure consisting of manned and unmanned modules stationed in various orbits and interconnected by a control system. The first phase of the program, which proposes creation of the manned part of the complex in a low near-Earth orbit and of a self-contained automatic platform in a polar orbit, is to be completed by 1996. In the assessments of American specialists, the cost of construction within the scope of the first phase will be $25-30 billion. It is proposed that up to $3 billion per year be allocated from the beginning of the 1990's for fulfilling this program.

On the whole, appropriations amounting to $13.1 and $14.6 billion respectively are being requested for NASA activity in FY 1990 and 1991.

The bulk of the military budget, around 97 percent, is directed to the Defense Department and is intended directly for technical outfitting and supporting day-to-day activity of branches of the Armed Forces.

The foreign press reports the following features in the **allocation of appropriations to the Defense Department by branches of Armed Forces.**

In recent years approximately identical amounts of from 31 to 33 percent of the Defense Department budget have been allocated for pay and outfitting of the Air Force and Navy (Table 2). The Army accounts for over 26 percent. The growth of absolute and relative amounts of appropriations for Defense Department agencies and departments is connected above all with the considerable volumes of financial resources being allocated to the Strategic Defense Initiative organization ($4.6 billion in 1990 and $5.4 billion in 1991).

Table 2—Distribution of Budget Appropriations to U.S. Defense Department by Branches of Armed Forces (in $ Billions)

	Fiscal Years			
Branches of Armed Forces	1988 (Actual)	1989 (Estimate)	1990 (Draft)	1991 (Draft)
Army	75.8	78.2	78.8	81.8
Air Force	88.3	94.6	97.7	103.0
Navy	100.3	97.4	97.8	103.1
Defense Department Agencies and Departments	19.4	20.0	21.3	23.1
Total	283.8	290.2	295.6	311.0

The dissimilar numerical and fighting strengths of branches of the Armed Forces dictate the differences in the structure of their budgets. For example, while over 50 percent of the Air Force budget and around 40 percent of the Navy budget is allocated for their technical outfitting (weapon and combat equipment procurement, research and development, military organizational development), the proportion of appropriations for these purposes in the Army budget is approximately 25 percent, while the bulk of it (over 70 percent) is directed toward personnel pay, combat training, and logistic support of forces.

A typical feature of the **allocation of appropriations to the Defense Department by specific purpose (by budget items)** in 1991 is a growth of funds for procurement of weapons and combat equipment after a five-year reduction. At the same time, the greatest share of the budget is intended for combat training and logistic support of troops (Table 3). This indicates a striving by the Defense Department leadership to increase the level of Armed Forces combat readiness and their capability to conduct protracted combat operations.

Table 3—Distribution of Budget Appropriations to U.S. Defense Department by Specific Purpose (in $ Billions)

	Fiscal Years			
Budget Items	1988 (Actual)	1989 (Estimate)	1990 (Draft)	1991 (Draft)
Military pay	76.6	78.6	79.2	81.3
Combat training and logistic support of troops	81.6	85.9	90.2	94.0
Weapon and combat equipment procurement	80.1	79.2	78.8	87.1
RDT&E	36.5	37.5	39.5	39.5
Military construction	5.3	5.7	4.8	5.6
Housing	3.2	3.3	3.2	3.6
Other (including offsetting receipts)	0.5	-	-0.1	-0.1
Total	283.8	290.2	295.6	311.0

Appropriations for weapon and combat equipment procurement by branches of the Armed Forces in fiscal years 1990 and 1991 are allocated as follows: the greatest share of funds (42 percent) is earmarked for the Air Force, the Navy's proportion is approximately 38 percent, that of the Army is 17 percent, and that of Defense Department agencies and departments is around 3 percent (Table 4).

Table 4—Distribution of Budget Appropriations to U.S. Defense Department for Procurement of Weapons and Combat Equipment by Branches of Armed Forces (in $ Billions)

	Fiscal Years			
Directions of Appropriations	1988 (Actual)	1989 (Estimate)	1990 (Draft)	1991 (Draft)
Army	14.9	14.9	14.2	14.3
Air Force	26.7	30.9	32.8	37.4
Navy	35.9	30.9	30.2	33.6
Defense Department agencies and departments	2.6	2.5	1.6	1.8
Total	80.1	79.2	78.8	87.1

It is planned to appropriate $32.8 (37.4)[1] billion for the *Air Force* for procurement of weapons and combat equipment. Half of these funds is intended for producing new and modernizing existing aircraft of strategic aviation, air defense aviation, tactical aviation and military transport aviation, helicopters of various types as well as spare parts for them. It is proposed to allocate $7.4 (10.1) billion for procuring missile and space equipment, and $8.6 (9.0) billion for other combat equipment. The financing of programs for procuring the main weapon systems for the Air Force is given in Table 5.

Table 5—Appropriations for Procurement of Main Weapon Systems for Air Force (in $ Billions)

	Fiscal years		
Designation of Weapon System	1989 (Estimate)	1990 (Draft)	1991 (Draft)
F-16C & D Fighting Falcon tactical fighters	3.0 (180)[1]	2.5 (150)	2.4 (150)
F-15E Eagle tactical fighter	1.4 (36)	1.5 (36)	2.0 (36)
C-17A military transport aircraft	1.0 (4)	2.0 (6)	2.6 (10)
MX (LGM-118A) ICBM	0.8 (12)	1.0 (12)	1.9 (12)
Maverick AGM-65 guided missile	0.3 (2,820)	0.2 (2,270)	0.2 (2,020)
AMRAAM AIM-120A guided missile	0.8 (874)	0.9 (1,450)	0.9 (2,200)
HARM AGM-88A antiradar guided missile	0.2 (893)	0.1 (326)	0.05 (200)

1. Number of weapon systems being procured given in parentheses.

It is planned to allocate $30.2 (33.6) billion for procuring weapons and combat equipment for the *Navy* (Table 6), of which $8.8 (9.5) billion will go for acquisition of aircraft, $9.6 (11.0) billion for acquisition of combatant ships and auxiliary vessels, $5.7 (6.0) billion for acquisition of missile weapons, guns, small arms and torpedoes, and $4.9 (5.7) billion for other military equipment. Under the Navy budget it is also planned to procure weapons and combat equipment for the Marines. In 1990 it is proposed to allocate $1.2 billion and in 1991 $1.4 billion for these purposes.

Table 6—Appropriations for Procurement of Main Weapon Systems for Navy (in $ Billions)

	Fiscal Years		
Designation of Weapon System	1989 (Estimate)	1990 (Draft)	1991 (Draft)
F/A-18 Hornet multipurpose aircraft	2.4 (84)[1]	2.5 (66)	2.1 (66)
F-14D Tomcat deck-based fighter	0.9 (12)	0.9 (6)	0.9 (12)
AV-8B Harrier V/STOL aircraft	0.5 (24)	0.6 (24)	0.5 (24)
EA-6B Prowler EW aircraft	0.5 (12)	0.1 -	0.4 (3)
E-2C Hawkeye early warning and control aircraft	0.3 (6)	0.5 (4)	0.4 (9)
SH-60B & F ASW helicopters	0.5 (24)	- -	0.3 (18)
Trident II SLBM	1.9 (66)	1.8 (63)	1.5 (52)
Phoenix AIM-54C guided missile	0.4 (450)	0.4 (420)	- -
AMRAAM AIM-120A guided missile	0.03 (26)	0.1 (150)	0.4 (800)
Harpoon AGM-84A antiship missile	0.2 (119)	0.2 (190)	0.2 (184)
HARM AGM-88A antiradar guided missile	0.3 (1,307)	0.3 (1,162)	0.4 (1,400)
Tomahawk BGM-109A & B sea-launched cruise missiles	0.7 (510)	0.6 (400)	0.7 (400)
Standard 2 surface-to-air missile	0.6 (1,310)	0.3 (590)	0.6 (900)
"Ohio"-Class SSBN	1.2 (1)	1.3 (1)	1.4 (1)
"Los Angeles"-Class SSN	1.4 (2)	0.9 (1)	- -
"Seawolf"-Class SSN	1.5 (1)	0.9 -	3.4 (2)
"Arleigh Burke"-Class missile destroyer	2.8 (4)	3.6 (5)	3.6 (5)
"Whidbey Island"-Class dock landing ship	- -	2.2 (1)	0.2 (1)

1. Number of weapon systems being procured given in parentheses.

The *Army* budget provides for appropriations for procuring weapons and combat equipment in the amount of $14.2 (14.3) billion (Table 7). These amounts are distributed as follows in $ billions by kinds of weapons and combat equipment: aircraft $2.9 (3.0), missile weapons $2.7 (3.0), artillery, small arms and armored equipment $2.7 (2.8), munitions $1.7 (1.6), and other kinds of combat equipment $4.2 (3.9).

Table 7—Appropriations for Procurement of Main Weapon Systems for Army (in $ Billions)

	Fiscal Years		
Designation of Weapon System	1989 (Estimate)	1990 (Draft)	1991 (Draft)
UH-60A Blackhawk multipurpose helicopter	0.4 (72)[1]	0.4 (61)	0.4 (61)
AH-64A Apache combat helicopter	0.9 (72)	0.9 (66)	0.8 (66)
MIM-104 surface-to-air missile for Patriot SAM system	0.8 (815)	1.0 (815)	0.9 (817)
MLRS	0.4 (48,000)	0.3 (24,000)	0.3 (24,000)
Stinger portable SAM system	0.2 (6,750)	0.1 (2,375)	0.3 (7,203)
TOW 2 ATGM	0.1 (12,000)	0.1 (9,455)	0.2 (13,284)
Missile for ATACMS tactical missile system	0.1 (66)	0.1 (152)	0.2 (452)
M2 Bradley IFV and M3 combat reconnaissance vehicle	0.7 (581)	0.6 (600)	0.7 (600)
M1A1 Abrams tank	1.4 (555)	1.3 (448)	1.2 (261)

Number of weapon systems being procured given in parentheses.

The military-technical aspect of modern U.S. military doctrine provides for constantly maintaining U.S. military-technical superiority over the USSR, which is confirmed by the significant volume of funds for **RDT&E.** It is proposed to allocate $39.5 billion for these purposes in each of fiscal years 1990 and 1991, which is 13.4 (12.7) percent of the entire Defense Department budget. As in the past, funds for developing future technologies, over 70 percent of which are being fulfilled within the scope of SDI, are growing at the highest rates. At the same time over one-third of RDT&E appropriations are being directed toward realizing tactical programs. It is proposed to allocate $5.7 billion in 1990 and $4.9 billion in 1991 for developing strategic weapon systems.

The greatest share of appropriations being requested by the Bush administration for RDT&E is earmarked for the Air Force—36.8 (34.2) percent (Table 8). Agencies and departments of the Defense Department are in second place, while the Navy was stable in this position in previous years. Changes in the structure of RDT&E financing are dictated above all by the significant volumes of financial resources being allocated to the SDI organization. The Navy's share of appropriations for RDT&E will be 24.9 (23.6) percent and that of the Army 14.4 (15.3) percent.

Table 8—Distribution of Budget Appropriations to the U.S. Defense Department for RDT&E by Branches of Armed Forces (in $ billions)

Branches of Armed Forces	Fiscal Years			
	1988 (Actual)	1989 (Estimate)	1990 (Draft)	1991 (Draft)
Army	4.7	5.1	5.7	6.0
Air Force	14.6	14.7	14.5	13.5
Navy	9.4	9.3	9.8	9.3
Defense Department agencies and departments	7.8	8.4	9.5	10.7
Total	36.5	37.5	39.5	39.5

The most costly RDT&E are developments of the ATF advanced multipurpose fighter ($1.1 billion in 1990 and $1.6 billion in 1991), the C-17A military transport aircraft ($0.9 and $0.5 billion), LHX multipurpose helicopter ($0.2 and $0.4 billion), MX ICBM ($0.8 and $0.5 billion counting the rail-based variant), Midgetman ICBM ($0.1 and $0.2 billion), SRAM II air-to-surface guided missile ($0.2 billion annually), and the Milstar satellite communications system ($0.7 and $0.6 billion).

Thus the direction of U.S. military policy has remained unchanged despite the fact that the world situation has improved somewhat in recent times (a process of eliminating intermediate and lesser range missiles is under way under the Treaty signed by the USSR and United States and talks presently are going on about a 50 percent reduction in strategic arms). The country's military-political leadership is continuing a course toward improving the Armed Forces' combat readiness and level of technical outfitting, above all through the development and procurement of highly effective weapon systems.

Footnotes

1. Here and further on, figures for FY 1990 are given ahead of the parentheses and figures for FY 1991 are given in parentheses—Ed.

Capabilities of Ports of European NATO Countries to Process Oil Cargoes

904Q0003N Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) pp 69-73

[Article by Capt 1st Rank A. Melnikov]

[Text] With the exception of Great Britain and Norway, European NATO countries satisfy their crude oil requirements basically through import. In the assessment of foreign specialists, over 1.5 million tons of petroleum and petroleum products are imported daily by Western European countries. As the OPEC statistical reference attests, oil production in Great Britain and Norway at North Sea and Norwegian Sea oilfields were 127 and 44 million tons respectively in 1986. This permitted exporting from two-thirds to three-fourths of the raw material obtained from these fields above all to the United States, Canada and Western European countries, appreciably reducing these countries' dependence on crude oil imports from countries of the Near East and Persian Gulf. In other Western European states the cumulative production of crude oil was only 22.3 million tons (from 1.4 million tons in Greece to 4.0-4.5 million tons in the FRG and the Netherlands). In 1986 Western European countries imported over 388 million tons of oil, including 72 million tons each by the FRG and France, 65.5 million tons by Italy, 41 million tons by Spain, 38 million tons by the Netherlands, 37 million tons by Great Britain, 21.9 million tons by Belgium, 16 million tons by Turkey, and an overall total of 25 million tons by Greece, Portugal, Denmark and Norway.

Creation of strategic stocks of petroleum and petroleum products in a theater of operations in peacetime assumes special significance under modern war conditions. Taking account of this fact as well as the dependence of a majority of Western European states on crude oil imports, the NATO military-political leadership decided in the early 1970's to establish an increased liquid fuel reserve in this region to satisfy needs of national and NATO Allied Armed Forces as well as needs of the economy.

In connection with the fact that petroleum and petroleum products are imported into Western European countries basically through seaports, the purposeful development of large specialized oil ports and an expansion of reserve stores of petroleum, fuels and lubricants at their location held an important place in the infrastructure of NATO countries during the 1970's and 1980's.

The largest ports and deep-water terminals for transshipment of petroleum cargoes have been created in this period in the cities of Immingham (Fig. 1 [figure not reproduced]) and Sullom Voe in Great Britain; Fos and Le Havre in France; Sines in Portugal; Incirliciftlik (Turkey); Rotterdam in the Netherlands; Wilhelmshaven in the FRG; Genoa, Trieste and Augusta in Italy; Cartagena, Algeciras, Tarragona, La Coruña and Bilbao in Spain (Figs. 2, 3 and 4 [figures not reproduced]); Slagen, Mongstad and Stavanger in Norway; and others (tables 1 and 2).

Table 1—Number of Tanker Berths in Ports of European NATO Countries

Country	Number of Ports Equipped with Tanker Berths	Number of Tanker Berths: Total	Number of Tanker Berths: Including for Tankers with Deadweight of 15,000 Tons or More
Great Britain	40	230	115
France	27	110	60
FRG	8	65	55
Netherlands	7	115	90
Belgium	4	30	20
Denmark	26	65	30
Norway	19	65	40
Spain	27	90	65
Italy	32	240	120
Portugal	7	20	15
Greece	14	47	26
Turkey	13	34	26
Iceland	5	8	1

Table 2—Main Ports of European NATO Countries for Processing Petroleum Cargoes

Port	Average Annual Freight Turnover, Millions of Tons	Maximum Deadweight of Tankers Received, Thousands of tons
Great Britain		
Sullom Voe	60	350
Milford Haven	32	275
Southhampton	23	100
Middlesbrough	22	150
London	20	100
Hound Point	17	300
Scapa Flow	16	200
Immingham	15	250[1]
Amlwch	7	500
Manchester	6	150
Liverpool	3	200[1]
Swansea	3	40
Finnart	2.5	330
France		
Fos	70	400
Le Havre	36	550
Donges	10	200[1]
Dunkirk	9	450
Lavera	8	80
Rouen	5	40

Table 2—Main Ports of European NATO Countries for Processing Petroleum Cargoes (Continued)

Port	Average Annual Freight Turnover, Millions of Tons	Maximum Deadweight of Tankers Received, Thousands of tons
Le Verdon	4.5	230
Sete	4	280
FRG		
Wilhelmshaven	20	300
Hamburg	16	110
Bremen	5	50
Brunsbüttel	4	125
Netherlands		
Rotterdam	110	350
Amsterdam	11	100
Terneuzen	10	100
Belgium		
Antwerpen	20	100
Ghent	About 4	70
Zeebrugge	About 2	70
Denmark		
Kalundborg	6	100[1]
Copenhagen	3	50
Gulfhavn	3	120
Fredericia	3	100
Aalborg	2.4	15
Aarhus	2	60
Norway		
Bergen	10.5[2]	20
Oslo	5[2]	40
Stavanger	2.5	200
Slagen	6	250
Mongstad	7	300
Spain		
Bilbao	15	500
Tarragona	14	325
Algeciras	12	500
Santa Cruz de Tenerife	10	240
Cartagena	9	250
Malaga	6	300
Las Palmas	4	500
Castellon de la Plana	6	135
La Coruña	7	120
Huelva	5	120
Barcelona	3	40

Table 2—Main Ports of European NATO Countries for Processing Petroleum Cargoes (Continued)

Port	Average Annual Freight Turnover, Millions of Tons	Maximum Deadweight of Tankers Received, Thousands of tons
Italy		
Genoa	30	500
Augusta	28	600
Cagliari	23	170
Trieste	20	100
Venice	14	80
Mellili	13	400
Milazzo	10	420
Livorno	8	40
Taranto	10	230
Naples	7	90
Savona	7	260
Gela	6	80
Civitavecchia	5	50
Fiumicino	4	220
Ravenna	4	250
Ancona	3.5	400
Porto Torres	3	300
Portugal		
Sines	8.5	350
Lisbon	5.1	65
Lexões	8[2]	120
Greece		
Eleusis	9.0[3]	60
Agios Theodoros	8.0	400
Megara	4.0	600
Salonika	2.5[3]	25
Turkey		
Incirliciftlik	40	300
Mersin	8	100
Istanbul	5[2]	250
Tutunciftligikoy	2	300
Aliaga	3	100
Iceland		
Reykjavik	3[2]	200

1. With incomplete load
2. General freight turnover of port
3. Foreign trade freight turnover of petroleum products

According to western press data, the overall capacity of petroleum and POL depots in seaport areas of NATO European countries more than doubled in comparison with 1975 and is around 290 million m^3, with Great Britain, the FRG, Italy, France and the Netherlands accounting for over 75 percent of the storage capacity. The largest underground oil depots with an overall capacity of around 35 million m^3 are in the vicinity of the cities of Wilhelmshaven and Bremerhaven. The main strategic stocks of oil and oil products on FRG territory are concentrated there.

The oil port of Sullom Voe (Shetland Islands), placed fully in operation in the early 1980's, is one of the largest in Europe. Up to 60 million tons of oil is pumped through it a year. It is intended for receiving oil (over two oil pipelines 175 km and 200 km long) and natural gas from oilfields in the Norwegian Sea, storing it, refining it and further transporting it to its destination. The port has four berths capable of receiving and processing tankers with a maximum deadweight of 350,000 tons and a roll-on berth for receiving ferries and RO-RO ships. Depots for crude oil with an overall capacity of 2.5 million m^3 and for liquefied gas (13,000 m^3), an oil purification plant (its basic purpose is to purify oil of water and gas and prepare it for tanker transportation), a thermal electric power station with an output of 125,000 kw, and an airfield are situated in the vicinity of the port. This port is designed for refining up to 220,000 m^3 of oil per day.

The industrial port complex of Fos, which is part of the port of Marseille, has been built on the Mediterranean coast of France. It is considered one of the most important in Western European countries for refining oil and oil products. There are eight berthing facilities, with depths of 6.5-23.3 m near them for receiving and processing tankers. This permits processing tankers with a deadweight up to 400,000 tons. All oil berths are connected with port storage facilities and oil refineries by pipelines. The overall capacity of oil and oil product depots is over 7 million m^3. In a year the port processes an average of 70 million tons of oil cargoes. Several pipelines originate in the port of Fos. The main one is the Main Southern European Oil Pipeline (782 km): Fos-Lavera-Karlsruhe (FRG). Its throughput flow capacity reaches 65 million tons per year.

The deep-water oil receiving terminal of Antifer has been built 20 km from Le Havre; conditions have been created there for simultaneously unloading two tankers with a deadweight up to 550,000 tons each. The oil storage facility with a capacity of 920,000 m^3 is connected with an oil refinery by a 26-km oil pipeline. Overall capacity of oil and POL depots near the port of Le Havre is 4.3 million m^3.

Wilhelmshaven is the main port in West Germany for receiving crude oil and oil products and a major center

for their stockpiling. Its oil receiving facility has eight berths for processing oil tankers with a deadweight up to 300,000 tons and a terminal for receiving gas carriers with a load-carrying capacity up to 60,000 tons. Underground depots with an overall capacity of around 25 million m^3 have been built in the port area for storing mobilization oil reserves. They are prepared in worked-out salt mines at depths of from 300 to 2,000 m. Oil is pumped into other areas over the 384 km Wilhelmshaven-Wesseling and 244 km Wilhelmshaven-Gelsenkirchen oil pipelines with a throughput flow capacity of 25 and 45 million tons of oil per year respectively, and over a new pipeline to the oil refinery in Hamburg.

A deep-water oil terminal has been created in Rotterdam (the Netherlands) in the new industrial port area of Maasflakt. It can process supertankers with a deadweight up to 350,000 tons. The capacity of terminal oil storage facilities is 4.3 million m^3. On the whole the port of Rotterdam is capable of receiving and processing up to 100 seagoing oil tankers of varying tonnage simultaneously. During the year around 110 million tons of oil products pass through it. A total of 14 oil and oil product depots have been built in the port with an overall capacity of more than 32 million m^3. The port is linked with Raunheim (near Frankfurt am Main) and Antwerp by oil pipelines. The first is 436 km long with a throughput flow capacity of 23 million tons per year, and the second is 105 km long with a capacity of 29 million tons.

In the assessment of foreign specialists, a network of oil pipelines has been established in Central Europe which provides for oil delivery from seaports of the North Sea and Mediterranean to oil refineries and oil storage facilities on the territory of the FRG, France and the Netherlands. In addition to the above, major main oil pipelines also include the Transalp (Trieste-Karlsruhe) and the Central European (Genoa-Ingolstadt) lines. Both of them end in those areas of the FRG where the main oil refineries meeting the needs of armed forces of the United States and NATO for fuel are concentrated.

Incirliciftlik, the largest bulk oil port in the Eastern Mediterranean, has been created in Turkey not far from the city of Iskenderun. It is intended for receiving oil over the 1,000 km pipeline from the Iraqi oilfield of Kirkuk and pumping it into tankers for further transportation to its destination. The port has four berthing facilities, each capable of simultaneously receiving and processing two supertankers with a deadweight of 150,000 and 300,000 tons. The terminal's overall oil pumping capacity is 60,000 m^3 per hour. There are seven storage facilities for temporary storage with a capacity of more than 900,000 m^3 of crude. The port processes over 40 million tons of oil per year.

According to foreign press data, the Western European NATO countries have an overall total of some 230 medium and large ports equipped with more than 1,100 berths for receiving and processing oil tankers. They process over 950 million tons of oil cargoes per year, which is more than double the annual requirements of European NATO member states. As a rule, the majority of large general-purpose ports also are equipped with special berths and devices for supplying merchant vessels and naval ships with necessary fuel and POL in case they enter port. The main flow of oil and oil products passes through approximately 90 large ports of the region (some of them are specialized bulk oil ports).

Those ports are capable of simultaneously processing over 650 tankers with a deadweight of 15,000-20,000 tons or more. Port facilities of 42 seaports are capable of supporting the loading or unloading of supertankers with a deadweight from 200,000 to 600,000 tons. Processing of supertankers with a deadweight up to 600,000 tons is possible in such ports as Sullom Voe and Amlwch (Great Britain); Le Havre, Dunkirk and Fos (France); Rotterdam (the Netherlands); Las Palmas, Algeciras and Bilbao (Spain); Genoa, Augusta, Ancona, Milazzo and Mellili (Italy); Agios Theodoros and Megara (Greece); and Sines (Portugal). Capabilities of the main ports for receiving and processing oil cargoes are given in tables 1 and 2.

Replenishing ship POL stores up to prescribed standards both from mobile service support vessels and in naval bases and ports holds a significant place in the system of logistic support of ship force groupings.

According to NATO command views, mobile service support forces for ships at sea are an important supplement to the fixed logistic support system organized in naval bases, berthing facilities and a number of ports of NATO countries.

Plants producing POL also can be considered POL supply bases for naval ships and transport vessels. Fuel bunkering of vessels is part of their day-to-day commercial activity and the presence of underground storage and deep-water berths permits presuming their use also in wartime.

The following are the main Western European ports serving to ensure the supply and rest of ship crews of NATO navies when active in waters of the East Atlantic, Norwegian Sea and Mediterranean: Oslo, Bergen, Trondheim, Stavanger and Tromso in Norway (in addition, special deep-water berthing facilities and underground POL storage capable of refueling ships have been prepared in the southern part of the country near the ports of Kristiansund, Arendal, Mandal and Brevik in accordance with a program for developing the NATO infrastructure); Reykjavik in Iceland; Invergordon, Southhampton, London, Liverpool, Glasgow, Hull, Leith and Swansea in Great Britain; Copenhagen, Kalundborg, Aarhus and Aalborg in Denmark; Hamburg, Bremerhaven and Bremen in the FRG; Antwerp, Zeebrugge and Ghent in Belgium; Rotterdam and Amsterdam in the Netherlands; Marseille, Bordeaux and Cannes in France; Lisbon in Portugal; Palma, Barcelona, Malaga, Cadiz, Alicante and Cartagena in Spain;

Augusta, Venice, Naples, Palermo, Genoa, Livorno, Trieste and Taranto in Italy; Piraeus and Salonika in Greece; and Istanbul, Izmir and Antalya in Turkey.

The NATO bloc leadership continues to devote special attention to the creation of special installations for prepositioning supplies on the territory of European NATO countries. For example, according to Norwegian press reports, new underground storage facilities for advance stockpiling of fuel and ammunition for supporting U.S. Navy ships, including aircraft carriers, in the period of their activity in the Norwegian Sea presently are next up for construction in Northern Norway.

On the whole, bloc military experts believe that seaports of European NATO countries have the necessary capacities for receiving and processing the requisite amount of oil and oil products in peacetime, for ensuring increased amounts under emergency conditions to satisfy the needs of national and NATO Allied Armed Forces and the needs of the region's economy, and for creating necessary mobilization stores of oil and POL.

U.S. Increase in Foreign Military Aid

904Q0003O Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) p 74

[Article by Col V. Mitrich]

[Text] Washington uses military aid, which as a rule is of a strictly selective nature, as an important means of achieving its military-strategic objectives. The largest amounts are allocated to Israel under various programs; beginning in 1985 all 100 percent of funds going to Israel in the form of military aid has been uncompensated. In early 1989 the United States specified eight countries as priority candidates for an increase in its military aid. They are the Philippines, Turkey, Portugal, Pakistan, Honduras, Jordan, El Salvador and Thailand. The figures given below characterize the extent of deals concluded by these countries in 1988 under the scope of various military aid programs provided by the United States ($ millions): Israel 1,800, Turkey 493.5, Pakistan 260.8, the Philippines 127.7, El Salvador 81.5, Portugal 85.1, Thailand 45.6, Honduras 41.2 and Jordan 28.2.

It is natural that in giving foreign states assistance in acquiring weapons and military equipment, the United States thereby ensures the right to retain its military presence on their territories and accomplish various political tasks. For example, in accordance with the American-Filipino agreement on military bases, the United States undertook to provide the Philippines with $900 million during fiscal years 1985-1989. Over the next five years it is proposed to transfer another one billion dollars to this country in the form of subsidies. The purpose of such assistance lies not only in fulfilling specific projects, but also in showing private foreign companies that investing funds in the Filipino economy is a reliable matter. It is planned to allocate $200 million in the form of military aid for 1990. Additional funds are intended for procuring supply items and new weapons for fighting guerillas, and for training various categories of service personnel.

Turkey's own military-industrial base which it is creating does not yet permit providing Armed Forces with modern weapons and equipment, and so they continue to come from NATO countries (and above all from the United States) under military aid, which in 1990 is increasing by $60 million compared with the previous year. Additional funds are directed toward continuing the fulfillment of modernization programs for M48 tanks, producing F-16 fighters, and purchasing spare parts and accessories to support the functioning of the Turkish Army's American-produced armament.

The increase in military aid to Portugal is connected with new conditions of the lease of the USAF base at Lagens (Lajes) in the Azores, although formally this is not stipulated in the agreement (in 1988 the Pentagon paid $23 million for its use). In 1990 the Portuguese Armed Forces will receive $125 million, which will go for implementing a program for building Type MEKO 200 missile frigates and purchasing 20 fighter-interceptors, 57 helicopters of various types, air defense weapons, other major weapon systems and supply items.

Beginning in 1954 (after the signing of a bilateral "mutual assistance" agreement) the United States became the chief supplier of arms to Pakistan. Military equipment already has been transferred to it repeatedly without compensation for outfitting infantry and armored divisions and air squadrons. The journal JANE'S DEFENCE WEEKLY notes that a new "super-injection" is aimed at "settling disorders on the Pakistani border." In fact this signifies assistance to antigovernment formations in Afghanistan. It is expected that military economic aid to Pakistan will be $627 million in 1990.

In Honduras additional resources (over $20 million) are to be directed toward replacement of obsolete Super Mystere aircraft with F-5 fighters, for personnel training, for logistic support for previously supplied U.S. armament, and for deliveries of modern patrol boats and aircraft to the Navy.

Military aid for Jordan is increasing to $50.2 million, which will be spent to make up for expended U.S. arms and for financing the procurement of logistic items.

Military and economic aid to El Salvador will grow to $386 million. The added funds will go to replenish reserve stores of weapons and equipment.

The main purpose for an increase in military aid to Thailand (by approximately two million dollars) is to carry out measures aimed at preserving close military ties and strengthening strategically important positions in Southeast Asia.

U.S. 2d Armored Division

904Q0003P Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) p 75

[Article by Col I. Malyshev]

[Text] The U.S. command is giving very careful attention to "heavy" large units intended for reinforcing American troops in the European zone during modernization of the Army deployed in the continental United States. Among these units is the Regular Army 2d Armored Division with headquarters at Fort Hood, Texas (the emblem is shown in the figure [figure not reproduced]). It is a "dual based" division for which heavy weapons and military equipment have been stockpiled in Europe. A feature of this large unit is the stationing of its III Brigade on FRG territory (headquarters in the city of Garlstedt). In case of mobilization deployment the division will be brought up to its wartime strength level with a National Guard separate tank battalion.

When the 2d Armored Division deploys in Europe it can have a headquarters and headquarters company, three brigade headquarters, six armored battalions, four mechanized battalions, division artillery (an MLRS battery, three 155-mm self-propelled [SP] howitzer battalions), army aviation brigade, air defense battalion, signal battalion, engineer battalion, intelligence and EW battalion, division support command, as well as a military police company and NBC company. It will have a total of 16,600 persons, 348 M1 Abrams tanks, 216 M2 Bradley infantry fighting vehicles, 118 M3 combat reconnaissance vehicles, 160 M577A1 command and staff vehicles, 336 M113A1 APC's, 48 TOW M901 SP ATGM systems, 240 Dragon ATGM systems, 72 155-mm SP howitzers, 9 MLRS launchers, 66 106.7-mm SP mortars, 18 Improved Chaparral SAM systems, 36 Vulcan SP AA guns, 36 Stinger portable SAM systems (fire teams), 127 helicopters including 44 AH-64A Apache fire support helicopters, up to 3,900 vehicles and over 5,300 radios.

U.S. military experts believe that completion of reorganization measures in the 2d Armored Division will significantly improve its combat capabilities.

New Weapon System for U.S. AH-64A Apache Helicopter

904Q0003Q Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) p 76

[Article by Col V. Nelin]

[Text] The U.S. firms of Martin Marietta and Westinghouse are developing the AAWWS (Airborne Adverse Weather Weapon System), which is to be one of the main elements in the program for phased improvement of the AH-64A Apache combat helicopter. The chief components of this system are a rotating millimeter band antenna accommodated above the helicopter's main rotor hub, the Hellfire ATGM with a new radar homing head (in place of a laser homing head), and appropriate electronics installed in the helicopter fuselage and cockpit.

The AAWWS system is being created for the AH-64A Apache (development has been under way since August 1986) to provide the capability of engaging tanks under adverse weather conditions. It is noted that in contrast to optical weapon guidance equipment, including lasers, the millimeter band radar is capable of functioning successfully under conditions of fog and rain. Operating in two frequency bands (35 and 94 GHz), it permits obtaining an image of rather high resolution for identifying tanks and other small targets on the battlefield. In addition, its small size and low power consumption are important arguments in favor of using such a system in the helicopter.

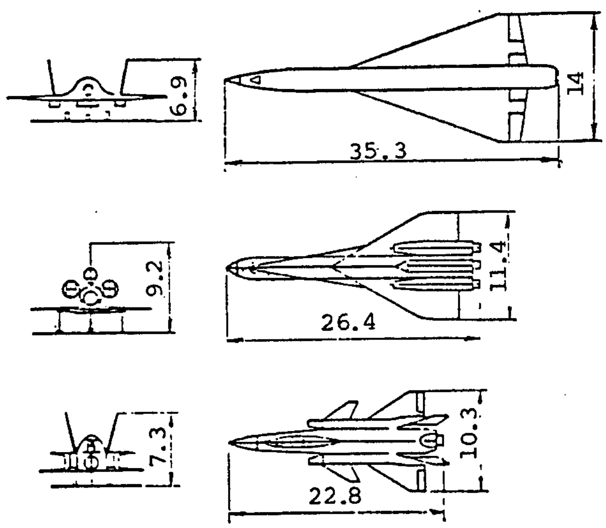
At the present time the firms of McDonnell Douglas, which produces the AH-64A, and Rockwell, which produces Hellfire missiles, also are participating in work of creating the AAWWS system. Demonstration models of the system were installed in two helicopters for flight tests. The first flew in the spring of this year. A check of system working capacity is planned for the end of the year. The foreign press reports that approximately a third of the fleet of AH-64A helicopters is to be equipped with the AAWWS system. It is believed that its first series models can become operational in 1993.

Development of an Experimental Hypersonic Aircraft in Japan

904Q0003R Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 9, Sep 89 (signed to press 15 Sep 89) pp 76-77

[Article by Col V. Yurtsev]

[Text] In attempting to keep up with the leading NATO countries, Japan's military-political leadership plans to accomplish the task of supporting manned space flights at the beginning of the next century. Creation of a single-stage aerospace plane which is to take off from and land on conventional runways and accelerate to great hypersonic speeds in the upper layers of the atmosphere with a subsequent exit into space is being considered as one of the most promising solutions. Japanese experts consider the collection and accumulation of data on flights of experimental aircraft at hypersonic speeds in upper layers of the atmosphere to be an important link in the chain of research on this problem.



Judging from foreign press reports, work to create a manned experimental hypersonic aircraft is being conducted in Japan by the firms of Kawasaki, Mitsubishi and Fuji. In the summer of 1988 the firms submitted preliminary proposals for developing such an aircraft for high-altitude flights at speeds of Mach 6-7 for consideration by the National Aerospace Laboratory. In particular, Mitsubishi submitted a project of a 32-ton aircraft with variable geometry delta wing and foreplane (see figure). Its power plant consists of two turbojet and two rocket engines. Kawasaki proposed the concept of a 40-ton aircraft with a configuration resembling the U.S. Space Shuttle. It is fitted with a variable delta wing and combination power plant which includes three turbojet and three rocket engines. The Fuji project took the design configuration of the French Concorde supersonic passenger aircraft as the basis. The aircraft is to weigh 50 tons and have a delta wing; it is proposed to equip it with two turbojet and two rocket engines.

The firms' technical capabilities for creating a hypersonic aircraft were evaluated and the technical tasks and problems to be solved were determined in the course of considering the above projects. Japanese specialists believe the main problem to be development of a reliable and highly efficient power plant using ramjet engines. Engines of this type operating on liquid hydrogen are the most economical in making lengthy high-speed flights in the atmosphere and are being considered as the basis of a power plant for the aerospace plane. Widescale research on such engines has been carried out by several Japanese firms since 1987.

Another consideration of experimental hypersonic aircraft projects is expected in 1990, after which it is proposed to begin full-scale development. In the assessment of Japanese specialists, it will require at least five years to create the aircraft and the expenses will be $0.8-1.5 billion.

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